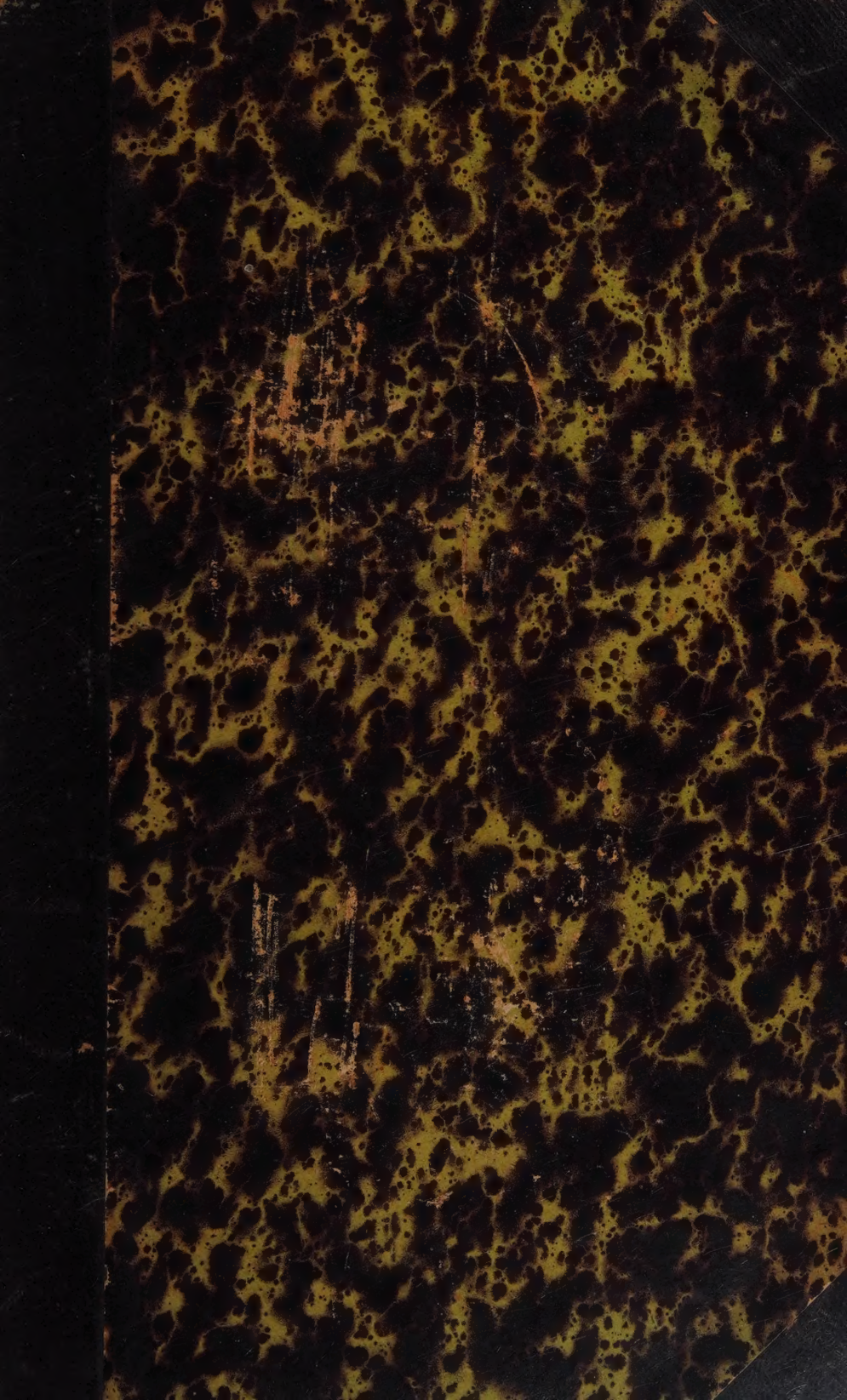




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[From the BULLETIN OF THE ESSEX INSTITUTE, Vol. X, Nos. 10, 11, 12, 1878.]

NOTES ON
PACIFIC COAST CRUSTACEA.

By W. N. LOCKINGTON.

Crangon nigricauda Stimpson.

The identity of this species with the *C. vulgaris* of the Atlantic is suspected. Owen, and after him Dana, mentions it as *C. vulgaris*, and Kingsley, in his "List of the North American Caridea" (Bull. Essex Inst., Vol. 10, Nos. 4, 5, 6, p. 54) says of *C. nigricauda*, *C. vulgaris*, and *C. alaskensis* Lock. (Proc. Cal. Acad. Sci., 1876, p. 34), "I am inclined to consider the three species above as the same, but need larger series to decide."

In an unpublished MSS., written previous to the publication of the above list, I find the following notes: "*C. alaskensis* does not appear, on further examination, to be distinct. Minute black spots, like those scattered over the body and hands in the specimens described under this name, are also abundant in fresh specimens of *C. nigricauda* from San Francisco Bay, and sometimes persist in alcohol."

This species, therefore, is known to range along the Pacific coast from Alaska to San Diego, from which last locality were obtained specimens which, from the persistence in a dried state of a single black spot on each side of the tail, were described by me as *C. nigro-maculata* (Proc. Cal. Acad., loc. cit.).

Crangon munitus Dana, U. S. Ex. Exp. Crust., p. 536, pl. xxxiii, fig. 5.

A well-armed form obtained in Magdalena Bay, Lower Cal., by W. J. Fisher, and having, besides the infra-orbital, antennal, and hepatic spines, four spines upon the upper surface of the carapax, one on each side of the centre line, and two spines in the centre line, the posterior one placed far back, must, I believe, be referred to this species, which is thus proved to have a very considerable range, since Dana obtained it in Puget Sound. The rostrum is broader than usual in the genus, and the last abdominal segment is exceedingly compressed, the abdomen tapering rapidly at the fifth segment.

Hippolyte taylori Stimpson, Jour. Bost. Soc. Nat. Hist., vi, p. 500 ext. p. 60), 1857.

Three or four specimens from Magdalena Bay (Fisher) evidently belong to this species, having the peculiar rostrum with the second and third spines almost above the terminal one. The stout first pair of feet, and the second pair reaching to the tips of the maxillipeds, as described by Stimpson. Length of largest specimen $1\frac{1}{10}$ inches.

Hippolyte palpator Owen, Zoology of the Voyage of the Blossom (Capt. Beechey), Crustacea, p. 89, pl. xxviii, f. 3, 1839. Stimpson, Proc. Cal. Acad., I, p. 89 (1856). *Ibid*, Jour. Bost. Soc., VI, p. 499 (1857).

H. brevirostris of Dana (U. S. Expl. Ex. Crust., I, p. 566, pl. xxxvi, f. 5) is not improbably a variety of this species (vid Stimpson, l. c., p. 500). A single specimen from the bay of San Francisco in the Museum of the California Academy has but one tooth on the under side of the rostrum near the extremity, which is bifid and furnished with six teeth above. The maxillipeds are very long, about half as long as the entire body, and are spinulose internally at their tips. The basal joint of antennulæ has a spine, longer than the rostrum, at its base. The next joint has a smaller lateral spine and there is a sharp spine on the last joint of the peduncle, immediately over the centre of the third flagellum. The telson has two rows of fine, short, sharp spines, and two larger spines on the posterior margin. The penultimate abdominal segment has two teeth on each side of the posterior margin and the epimera of the two preceding segments are prolonged backward into a spine.

The chief difference between this and Owen's description of *H. palpator* is in the number of rostral teeth, but as these are variable in this genus I hesitate to describe it as new, preferring to refer it to one of the above forms.

Several specimens from Magdalena Bay agree with *H. palpator* in the length of external maxillipeds, but have the rostrum with four teeth above. *H. palpator* was found at Monterey by Capt. Beechey, in the Straits of De Fuca by the Exploring Expedition, and in San Francisco Bay (Stimpson).

Hippolyte hemphilli, described by myself (Proc. Cal. Acad., vii, p. 35 (1876)) from an imperfect dried specimen, is probably only a variety of the above species with an extremely short rostrum. This variety has been found at Magdalena Bay and San Diego. The rostrum is equal in length to the eyes; the terminal tooth is simple, the next smaller and considerably behind the terminal one.

Hippolyte layi Owen, l. c., p. 90, p. xxvii, f. 3.

Owen's description of this species is very brief and the rostrum only is figured. Two examples in the collection of the California Academy from the west coast of Alaska, north of Behring's Straits, agree so nearly with *H. layi* in the form of rostrum that I believe them identical. According to Owen the rostrum has ten spines above and four below, besides the terminal tooth. The specimens above referred to have, as in Owen's figure, a long lamellate ensiform rostrum, below well in front of the eyes are five nearly equal teeth, directed forwards, rostral tip long and sharp; above with seven unequally spaced teeth, the three posterior ones near together and on the carapax. Rostrum as long as or longer than the carapax, and has a thickened midrib from which the spines project as lamellæ of varying width. Antennal spine prominent. One specimen has a prominent spine upon the abdomen at the bend of its central segment. External maxillipeds comparatively short, and hidden entirely beneath the antennal scales. Basal joint of antennulæ spinose. Total length $1\frac{3}{4}$ inches.

Palæmon longipes. Nov. sp.

Rostrum longer than antennal scale, reflexed towards extremity, armed with eight teeth above, and six below, without including the slender bifid terminal tooth. First teeth on upper margin, small, situated on the carapax, and separated from the following six, which are close together, eighth tooth nearer the tip than to the seventh tooth. Six lower teeth nearly equidistant, the first (beginning at the rear) immediately beneath the sixth of the upper series, the sixth beneath the eighth upper tooth. A spine on each side of the carapax, immediately above the antennal scale, and a second spine farther back and slightly below the first. Peduncle of antennulæ shorter than the antennal scale, basal joint armed with a strong spine externally, two external flagella united for some distance, the inner of the two very short, the outer very long, exceeding in length the internal flagella.

Antennal scale longer than peduncle of antennulæ, flagellum as long as the body from tip of rostrum to tail.

External maxillipeds, when extended, reaching somewhat beyond the antennal peduncle, slender, setose, especially on the terminal joint.

First pair of limbs slender, cylindrical, meros half as long again as ischium, carpus longer than meros, and three times as long as the manus; fingers blue, closely fitting, nearly as long as palmer portion of manus.

Second pair of legs exceedingly long and slender (in the male), ischium comparatively short and very slender; meros more than twice as long as ischium, and stouter; carpus exceeding the meros by two

thirds; propodus slightly longer than carpus; fingers parallel, slightly deflected from the line of the palm, without teeth, their inner and outer surfaces densely pubescent.

Manus of the second pair minutely spinulose to the base, of the fingers; carpus and meros spinulose, the spinules larger on the under surface, where they form distinct longitudinal rows.

Posterior legs smooth, cylindrical, sparsely pubescent.

Terminal segment of abdomen with seven spinules, three at the tip the central one fixed, the lateral ones articulated, and two pairs situated farther forward, the anterior pair at about the middle of the length of the segment.

Three or four specimens were taken in Mulege River, on the West coast of the Gulf of California, by W. I. Fisher.

This species closely resembles *P. dasydactylus* Streets (Proc. Phil. Acad., 1871, 225) which is quoted by Kingsley, in his List of North American Caridea (Bull. Essex Inst., Vol. X, Nos. 4, 5, 6) as a synonym of *P. forceps* M. Edward. The principal differences traceable are in the proportions of the joints of the first pair of legs, the manus in the present species being shorter than in *P. dasydactylus*, in the greater length of the articulations of the second pair in this species, as compared with their thickness; and in the spines of the terminal abdominal segment, which are only five in Dr. Streets' species.

The differences are so small, and the resemblances so great, as to suggest the possibility of actual near relationship; and it is not improbable that in this form we meet with the descendants of such of the Atlantic *P. forceps* as penetrated into the Pacific when the oceans were connected at what is now the Isthmus of Panama.

The female resembles the male, except in the second pair of limbs, which are much smaller, smooth, shorter, and more slender, and have the proportions of the joints reversed, the manus shorter than the carpus, and the latter shorter than the meros.

The specimens were obtained in August, and the females were loaded with ova.

The teeth on the upper side of the rostrum vary somewhat, the tip, which is blunt in one specimen, is bifid in another, and one of the males has only eight teeth on the upper edge.

Following are the dimensions of a male and female:—

	♂	♀
Total length,	105 millims.	82 millims.
Length of carapax, including rostrum, .	51 "	37 "
“ “ flagellum of antennæ, . . .	110 "	95 "
“ “ outer flagellum of antennulæ, .	90 "	— "
“ “ first pair of legs,	39 "	25 "

	♂	♀
Length of second pair of legs, . . .	167 millims.	39 millims.
" " third pair of legs, . . .	55 "	— "
" " manus of first pair, . . .	60 "	10 "
" " carpus " . . .	55 "	13 "
" " meros " . . .	35 "	16 "

Notwithstanding the great difference in the proportions of the joints of the second pair of limbs in the males and females, I think there is no doubt they belong to the same species, since they were taken on the same occasion, and in other respects resemble each other closely.

In every point except those mentioned above, my specimens agree with Streets' description and figure, yet they are from the western shore of the Gulf of California, while his specimens were from Coatzoalios River, Isthmus of Tehuantepec, and the species has always been known as an Atlantic one. Yet the differences are so small as to be, in my opinion, only varietal, and a parallel case occurs in the genus *Alpheus*, where *A. heterochelis* and *A. minus* are common to both the Atlantic and Pacific shores.

Pontonia margarita *S. I. Smith*, Am. Naturalist, 1869, vol. III, p. 245, foot note.

This species, originally described from individuals collected at Panama, was taken in considerable numbers at Port Escendido, Mulege Bay and Gulf of California, by W. I. Fisher, in August, 1876, at which date the females were with spawn.

The color after a month in spirits, was a light rose tint, with occasionally some dark markings upon the hands.

The specimens agree in every respect with Smith's description, and inhabited the same shell, viz., *Margaritophora fimbriata*.

Pontonia pinnæ nov. sp.

Body slightly depressed; carapax smooth, rostrum elongate-triangular, deflected, the tip lying between the base of the antennulæ; antennal spine prominent.

Peduncles of eyes short, broad ovate, cornea much narrower than the peduncle.

Peduncle of antennulæ exceeding the rostrum by the length of its distal joint, flagella not longer than the two last joints of the peduncle subequal, the outer stouter than the inner.

Antennal scale broad, as long as antennular peduncle, antennal flagellum extending backwards to about the middle of the carapax.

First pair of limbs slender, carpus and meros sub-equal, propodus about two thirds the length of carpus, dactyli about equal to palmar portion.

Second pair greatly developed, equal to the body in the female, and exceeding it in the male; propodus stout, dactyli one half as long as the palmar portion, pollex with two large obtuse teeth on its inner border, and a slightly hooked point, dactylus slender, with a large sharp-pointed, triangular, compressed tooth in the middle of its length, closely fitting between the teeth of the pollex.

Dactyli of hinder four pairs bi-unguiculate.

Three last segments of pleon compressed, a spine on each side of the posterior border of the penultimate segment.

Total length of a well-grown specimen from tip of rostrum to end of abdomen, about 34 millims; length of manus of adult male, 17 millims; ditto of a well-grown female 13 millims.

The females are similar to the males, but the manus of the second pair is somewhat shorter.

Several specimens were taken from the interior of the shell of the common *Pinna*, of the Gulf of California; localities: Angelas Bay, Mulege Bay, San José Island. They were collected in the months of July and August, at which date the females were loaded with eggs.

From *P. margarita* S. I. Smith, this species may readily be distinguished by the much greater development of the manus of the second pair. From M. Edwards' description of *P. tyrrhena* (Hist. Nat. des Crust., Vol. II, p. 361), which inhabits the *Pinna* of the Mediterranean, this species differs in lacking the tooth upon the rostrum.

***Sicyonia penicillata* n. s.**

Rostrum deep, shorter than peduncles of eyes, with four spines above, one forming the tip, the next immediately above and slightly posterior to it, the third midway between the second and fourth, which is upon the carapax. Carina of rostrum extending backwards the whole length of the carapax; developing a strong spine, directed forwards, just anterior to the centre of the carapax, and a stronger similar spine near its posterior border.

Central carina higher behind the former of these spines, curving upwards to the posterior spine, then downwards till it disappears on the posterior border of the carapax.

Spines of rostrum preceded by a few hairs, the central spine of carapax by quite a mane of hairs, and the posterior spine with a similar mane.

A spine on the exterior orbital margin, and a second posterior to it, on the hepatic region.

First segment of pleon with a triangular spine, behind which a low central carina is continued to the extremity of the sixth segment of the pleon, rising into a spine on the posterior margin of the fifth and sixth segments.

Ophthalmic peduncle shorter than the basal joint of antennulæ, cornea large, broader than the peduncle, its width about equal to the length of the visible portion of the latter.

Basal joint of antennular peduncle broad, armed with two sharp lateral spines, one behind the other, in a line with the lateral spines of the carapax; flagella of antennulæ scarcely as long as the two distal joints of the peduncle, the joints much shorter than broad.

Spine of antennal scale extending slightly beyond the antennular peduncle, the squamose portion broad, not longer than the spinose portion.

Peduncle of antennæ slightly shorter than that of antennulæ, its terminal joint setose on its internal margin, flagellum much shorter than the body, its articulations broader than long, especially the proximal portion, where they are depressed and margined with seta internally and externally.

Outer maxillepedes extending beyond antennal peduncle, the propodus margined internally with long setæ.

Meros, carpus and propodus of first pair of legs equal in length, all the joints of second pair longer, but the carpus longer than the meros; in the third pair, which extends beyond the outer maxillipeds when straightened, all the joints are longer than in the second pair, and the slender carpus almost twice the length of the propodus.

Propodi of three first pairs similar, that of the third pair somewhat longest, fingers parallel, equal to the palmer portion in the first and second pairs, but shorter in the third.

Fifth pair longer than the fourth, dactyli laminate.

A spine at the tip of the outer caudal appendage externally.

Length of a large specimen,		3½"
Length of carapax,		0.35"
Length of outer antennæ,		1.85"

Dredged from a depth of 14 fathoms, in Bolinas Bay, Lower California; also obtained in Angeles Bay, Gulf of California. (W. J. Fisher.)

Color after two weeks exposure to alcohol, bright red; with a dark red-brown ocellated spot on each side of the carapax. Antennæ bluish.

A longer exposure to alcohol has bleached the body, but the antennæ still show traces of blue, and the spots on the carapax, though obsolete in one specimen, remain dark and conspicuous in another.

This form resembles *S. carinata* Dana (U. S. Ex. Exp. Crust., I, p. 602), but the rostrum is more prominent.

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
WILLIAM S. DALLAS, F.L.S.,

WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,

AND

WILLIAM FRANCIS, Ph.D., F.L.S.

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VOL. I.—FIFTH SERIES.  
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1878.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. : . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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*Remarks upon the Thalassinidea and Astacidea of the
Pacific Coast of North America, with Description of a
new Species.* By W. N. LOCKINGTON.

THALASSINIDEA.

Family Gebidæ.

Gebia pugettensis, Dana.

Gebia pugettensis, Dana, U.S. Ex. Exp., Crust. i. 510, pl. xxxii. fig. 1;
Stimpson, Crust. & Echin. P. S. N. Am. p. 48.

This species is exceedingly abundant in San Francisco and Tomales Bays, and frequently attains a length of six inches or even more.

The subterranean passages made by it are usually nearly perpendicular, about an inch across, and very neatly rounded in section, with the walls smooth as if plastered, the smoothness resulting entirely from the pressure of the animal's body as it pushes itself upwards and downwards by the action of its terminal abdominal segments.

The burrows are not confined to strata of sand, but are abundant also in mud, in sandy shingle, and even among rocks, ranging upwards almost to high-water mark, and downwards to at least three or four fathoms, since large specimens were brought up in abundance by the dredging-machines in Oakland Harbour.

Almost every specimen collected in Tomales Bay, in the month of May, bore upon its abdominal feet either the curious Isopod *Phyllodurus abdominalis* (Stimpson, *op. cit.* p. 71), or a small bivalve mollusk, *Pythina rugifera*, Carpenter.

While most of the smaller individuals are accompanied by a pair of *P. abdominalis*, the larger specimens were free from this crustacean, but in many cases bore the mollusk above mentioned.

In only one case, out of over a hundred specimens dug up in Tomales Bay, were the mollusk and the Isopod found in company upon the same *Gebia*; and in this case the *Gebia* was of middling size, and the mollusk very small. On specimens collected July 4 I did not find the bivalve, and the *Phyllo-durus* was less common than in May.

In San-Francisco Bay I have not as yet detected *Pythina rugifera*, but *Phyllodurus* is sufficiently common.

Gebia pugettensis is on record from various points along the Pacific coast from Puget Sound to Monterey, and also from San-Quentin Bay, west coast, Lower California.

Gebia spinigera, S. I. Smith.

Gebia spinigera, S. I. Smith, Report Peabody Acad. Sci. 1869, p. 92.

A large number of specimens, all females, were collected by J. A. M'Neil, at the island of Aseredores, 20 miles north-west of Corinto, Nicaragua; and a few were also collected in the Gulf of Fonseca.

Gebia longipollex, T. H. Streets.

Gebia longipollex, T. H. Streets, Proc. Acad. Nat. Sci. Phil. Dec. 1871, p. 242.

This species, having a tridentate front, and a small spine on the carapax over each antenna, is described in a "Catalogue of Crustacea from the Isthmus of Panama," collected by J. A. M'Neil, and probably came from the Pacific coast of the isthmus.

Gebia rugosa, nov. sp.

Rostrum short, thick, obtuse at tip, curved downwards to the level of the centre line of the cornea of the eye. Upper orbital margin curving outwards convexly; margins of anterior portion of carapax, posterior to the curve, straight, but gradually divaricating. Upper surface of rostrum and carapax, to about halfway to the dorsal suture, beset with small tubercles and hirsute.

Cornea black, visible from above between the rostrum and the outward curve of the carapax.

Antennæ projecting beyond rostrum to a length about equal to that of carapax, sparsely setose.

Antennulæ less than half the length of antennæ, branches of flagella equal, the upper stouter than the lower.

Chelipeds equal; merus compressed, smooth, equal in length to the hand; carpus smooth, about half the length of upper margin of propodus; propodus smooth, sparsely hirsute, the hairs most abundant on inner side; pollex short, sharp-pointed, curved regularly upwards; dactylus less than half the length of palmar portion of hand, which is thickly hirsute, curved regularly downwards, its tip passing beyond that of the dactylus.

Four hinder pairs of pereopodi compressed, the posterior margins and tips of the propodi hirsute, also, to a less extent, the posterior margins of the carpi.

Anterior margin of the merus and propodus of the second pair set with long hairs.

Posterior margin of fourth abdominal segment beset with short stiff hairs; the three posterior segments and the lateral caudal appendages complexly wrinkled above, the rugæ smooth. Terminal segment broader than long, distal margin longer than proximal; caudal processes large, filling up the space between the terminal and fifth segments.

Length of larger specimen 25 millims.

Two specimens of this species were collected at Port Escondido, Gulf of California, under stones and coral at low tide, August 1876.

Callianassa californiensis, Dana.

Callianassa californiensis, Dana, Proc. Acad. Nat. Sci. Phil. 1854, vii. p. 175; Stimpson, Crust. & Echin. P. S. N. Am. p. 49, pl. xxi. fig. 4.

Stimpson records the occurrence of this species at Fort Steila-coom, Puget Sound (*Suckley*), and near the mouth of San-Francisco Bay (*Trask*). I have not been fortunate enough to meet with it in the latter locality, but have found it in abundance near Preston's Point, Tomales Bay.

In the museum of the Cal. Acad. Sci. are several specimens from Mutiny Bay, Alaska.

Both the anterior feet of the female are of a bright rose colour; but the large hand of the male is nearly of the same tint with the body.

Upon specimens I collected in Tomales Bay were numerous minute red parasites which I neglected to examine, but conjecture to have been Acarida.

Callianassa gigas, Dana.

Callianassa gigas, Dana, U.S. Ex. Exp., Crust. i. 212, pl. xxxii. fig. 3 :
Stimpson, Crust. & Echin. P. S. N. A. p. 49.

I have not met with this species in the vicinity of San Francisco; nor does it occur among the numerous species of Crustacea, including two new Thalassinidea, collected by Fisher on the coasts of the Gulf of California.

Dana met with it in Puget Sound.

Callianassa longimana, Stimpson.

Callianassa longimana, Stimpson, *op. cit.* p. 50, pl. xxi. fig. 5.

This species, originally collected at Fort Steilacoom, Puget Sound, by Dr. Suckley, occurs also at Santa-Rosa Island, one of the Santa-Barbara group, at San Diego, and at San-Quentin Bay, Lower California. Doubtless it occurs at points intermediate between these widely separated localities.

Callianidea typa, M.-Edwards.

Callianidea typa, M.-Edwards, Hist. Nat. des Crust. pl. xxv. bis, figs. 8-14.

It was with some surprise that I found, among other specimens of Crustacea collected by Mr. W. J. Fisher in the Gulf of California, some examples of this species, first collected by Messrs. Quoy and Gaimard upon the coasts of New Ireland. After careful examination I cannot detect any difference between my specimens and the figures given by Milne-Edwards, although the localities are so wide apart.

The specimens, three in number, were taken at La Paz at low tide.

Total length of second largest specimen 50 millims.; length of smaller hand 10, of larger 15. Length of manus of larger cheliped of largest specimen 24 millims., of palmar portion 14, of carpus 3, of merus 11; of manus of smaller cheliped 15, of carpus 8.5, of merus 8.5; width of manus of larger cheliped 10.

ASTACIDEA.

Panulirus interruptus, Randall.

This is the "lobster" of the San-Francisco market. Large numbers are caught at Santa Barbara and other points south of San Francisco.

Stimpson states that it inhabits rocky ledges in rather deep water.

Said to occur though not abundantly, in Monterey B., as far N. as St. Cruz. Johnson has known sp. to be caught in S. F. Bay, but thinks it possible these escaped from a schooner a well, formerly running with them from St. Barbara.

Panulirus guttatus, Gray.

Dr. T. Hale Streets mentions this species among those collected by J. A. McNeil upon the Isthmus of Panama, presumably from the Pacific coast.

Panulirus americanus, Lamarek.

Also included in the above-mentioned catalogue.

Panulirus gracilis, Streets.

Panulirus gracilis, Streets, Proc. Acad. Nat. Sci. Phil. 1871, 225, pl. xi. fig. 2.

This form is described by Streets from a specimen 0.9 inch in length, probably a very young individual.

Astacus Gambelii, Agassiz.

This very distinct species appears to be peculiar to the central region of North America; all the specimens I have seen have been collected east of the Sierra Nevada.

It is easily distinguished from the species inhabiting the rivers flowing into the Pacific, by the pilose areas upon the upper surface of the chelæ, and by the simple rostrum.

Astacus nigrescens, Stimpson.

Astacus nigrescens, Stimpson, Crust. & Echin. P. S. N. A. p. 52.

This species appears to be found in most of the larger brooks of the central counties of California, such as the Alameda Creek, Alameda Co., Coyote Creek, Santa-Clara Co., and San-Joaquin Slough.

It is occasionally sold in the markets of San Francisco. Adult specimens exceed 4 inches in length.

Astacus klamathensis, Stimpson.

Astacus klamathensis, Stimpson, *op. cit.* 54.

This small species, first found in Klamath Lake by Dr. Newberry, has also been taken in the Columbia River; and I have collected several individuals in Eel River, Humboldt Co., California.

Astacus Trowbridgii, Stimpson.

Astacus Trowbridgii, Stimpson, *op. cit.* 53.

The terminal spine of the rostrum is less slender than in *A. nigrescens*; and a single prominent antero-lateral tooth on

each side supersedes the five or six small sharp spines of that species. The edges of the terminal spine are serrated.

Astacus læviusculus, Dana.

Columbia River, Puget Sound.

San Francisco, Aug. 28, 1878.

[*From the ANNALS AND MAGAZINE OF NATURAL HISTORY for*
November 1878.]

REMARKS
UPON THE
PORCELLANIDEA
OF THE
WEST COAST OF NORTH AMERICA.

BY
W. N. LOCKINGTON.

THE accompanying list of Porcellanidea (which includes descriptions of nine species I believe to be new, since they are certainly distinct from any of those described or mentioned by Stimpson as found upon this coast) does not profess to be complete, but merely to give facts of distribution and other particulars respecting forms with which I am acquainted.

Stimpson, in his 'Prodr. des Anim. évert.' 1858, divides the old genus *Porcellana* into the following genera:—*Petrolisthes*, *Pisosoma*, *Raphidopus*, *Pachycheles*, *Megalobrachium*, *Porcellana*, *Minyocerus*, *Porcellanella* (White), and *Polyonyx*.

In the first two of these the first joint of the antennal base is short, not reaching the margin of the carapax; while in all the others the first joint is more or less produced, and joined to the margin of the carapax.

The more convex carapax, stouter chelipeds, and less projecting front are the characters which separate *Pisosoma* from *Petrolisthes*; but as some of my species have some of the characters of the former genus, while they are without others, I find it exceedingly difficult to discriminate. I have therefore included *Pisosoma* in *Petrolisthes*, placing the former name in brackets before the specific names of such species as, in my

belief, will belong to it if it be retained by carcinologists. Of the other genera, *Pachycheles*, *Porcellana*, and *Polyonyx* are found on this coast. These genera are distinguished from each other by well-marked characters: the first by its stout rough chelipeds and short carpus; the second by the long narrow carapax, prominent front, and deep orbits; and the third by its broad carapax, and by the bi- or multiunguiculate dactyli of the ambulatory feet. The former character distinguishes *Polyonyx* from *Porcellanella* (White).

Most of the Pacific-coast species belong to the genus *Petrolisthes*, which is, moreover, by far the largest section of the old genus *Porcellana*.

The total number of species here recorded is sixteen, nine of which I believe to be new; twelve belong to *Petrolisthes* (including *Pisosoma*), two to *Pachycheles*, one to *Porcellana* as restricted by Stimpson, and one to *Polyonyx*.

I have examined specimens of all the species except *Petrolisthes gracilis*, *erimerus*, and *occidentalis*.

All the presumably new species here described are from either the east or west coast of the peninsula of Lower California, a district which has not as yet been thoroughly explored for its marine fauna, although large collections of birds, fishes, echinoderms, and alcyonarians have found their way thence to the museums of the eastern States.

Genus PETROLISTHES.

a. Carapax flat, ovate; carpus at least twice as long as wide.

Carpus three times as long as wide; anterior and posterior margins parallel, straight, and smooth, with a sharp tooth at posterior distal end.....

P. gracilis.

No teeth in front of carpus, but a prominent inner lobe and a tooth at posterior distal end; front triangular, depressed.....

P. rupicolus.

Front less prominent than in the last species; no prominent inner lobe to carpus; posterior margin of carpus denticulated.....

P. erimerus.

Carpus with two or three teeth in front and a tooth at posterior distal end; dactylus of larger cheliped strongly hooked; all the limbs fringed with long setæ.....

P. hirtipes.

Postorbital tooth not spinous; carapax covered with short plications; carpus with four blunt teeth in front.....

P. crenulatus.

Postorbital tooth spinous; a second spine behind this, from which a ridged margin runs backward; carapax and chelipeds rugose.....

P. occidentalis.

Postorbital tooth obtuse, a spine behind it; carpus with three acute teeth in front; meros of

- ambulatory feet with two or three spines on upper edge, and one at posterior distal end. . . *P. armatus.*
- Pre- and postorbital spines acute; front boldly triangular, a spine behind postorbital; carpus spinous before and behind; chelipeds equal; meros of ambulatory feet with a row of spines anteriorly; carapax and all the limbs pubescent *P. Edwardsius?*
- b. Carapax convex; carpus short; chelipeds stout. Carpus nearly twice as long as wide; carpus and manus with three longitudinal rolling ridges; chelipeds equal. *P. sinuimanus.*
- Carpus as broad as long, front margin laminate; hands flat; chelipeds subequal *P. gibbosicarpus.*
- Hands dissimilar; carpus nearly as broad as long, its laminate front margin with three crenulated teeth *P. setimanus.*
- Carpus as broad as long; front lamina in three low lobes; carapax and chelipeds smooth and shining; a white spot behind each eye on antero-lateral margin *P. biocellatus.*

Genus PACHYCHELES.

- Carapax with a raised margin, front entire; chelipeds very unequal; carpus very short, not toothed in front; manus protuberant along the centre *P. rudis.*
- Carapax and limbs with long pubescence, front trifid; chelipeds equal, with large tubercles above; carpus with a single large lobular tooth in front *P. tuberculipes.*

Genus PORCELLANA.

- Carapax exceedingly elongate; postorbital acute, a spine on antero-lateral margin behind; chelipeds subequal; a small spine in front of carpus *P. transversilineata.*

Genus POLYONYX.

- Carapax and limbs smooth; chelipeds equal; carpus with a deep concavity in front for the manus; dactyli of ambulatory feet multi-ungiculate *P. nitidus.*

Petrolisthes gracilis, Stimpson.

Petrolisthes gracilis, Stimpson, Ann. Lyc. Nat. Hist. vii. p. 74.

I have not examined any specimens which answer to Stimpson's description of this species.

Petrolisthes rupicolus, Stimpson.

Petrolisthes rupicolus, Stimpson, Prodr. des Anim. évert. p. 65.

This species appears to have a wide range. To the south it extends along the west coast of Lower California (Asuncion

Island, *Fisher*), and also along the Gulf coast of the same peninsula (Port Escondido; Las Animas Bay, *Fisher*); it is found on the islands of the Santa-Barbara group (Santa-Rosa and San-Miguel Islands, *Harford*), and thence by Monterey and the Farallones northward at least to Tomales, on the ocean-beach near which place I have procured it in abundance. Probably it extends much further to the northward.

It is abundant on rocky beaches in some parts of San-Francisco Bay.

Petrolisthes eriomerus, Stimpson.

Petrolisthes eriomerus, Stimpson, Ann. Lyc. Nat. Hist. N. Y. x. p. 119.

It is not very unlikely that this may prove to be a variety of *P. rupicolus*. All the examples of the latter species that I have examined have the tuft of hair between the fingers below; in many the posterior or outer edge of the carpus appears denticulated in consequence of the projecting edges of the short rugæ, which continue some distance down the outer surface; and the prominence of the laminate inner lobe varies in different specimens. I have a young *Petrolisthes* which has a slightly triangular front (projecting much less than that of a somewhat larger *P. rupicolus*), and the two sides of the carpus parallel. So far it agrees with *P. eriomerus*; but the posterior margin of the carpus is not denticulated, and the ambulatory feet are not "everywhere hairy," but covered with granules, except a few hairs on the dactyli.

I believe this specimen to be the young of *P. rupicolus*.

Petrolisthes hirtipes, nov. sp.

Carapax slightly longer than wide, somewhat pentagonal, a single lobular tooth behind the eye; upper surface tomentose, granular anteriorly.

Front three-lobed, margined with setæ, central lobe low and broad; no postorbital spine.

Eyes large and projecting.

Antennal peduncle armed with tubercles, the largest on the anterior portion of the penultimate joint.

Meros of chelipeds short, with a long tooth at its anterior distal end; carpus about twice as long as wide, with two or three teeth on its anterior margin, and a long tooth at its posterior distal extremity; manus flattened, thickest along the centre of its length, and broadest at the insertion of the dactylus; dactyli dissimilar, that of the left cheliped stout, inserted somewhat obliquely, and very strongly hooked at the tip, which is obtuse and overpasses that of the pollex, that of the right cheliped with the inner edge straight, the tip sharp-

pointed and slightly bent; pollex of right cheliped with an obtuse tip, that of left sharp and slightly bent inwards.

Upper surface of manus, carpus, and meros covered with tubercles; two distinct longitudinal series of tubercles on each dactylus; the inner margin of the left dactylus, outer margin of both propodi, and inner margin of carpus clothed with a fringe of long setæ.

Ambulatory limbs tomentose above, with a long fringe of setæ on both margins; upper surface granular.

Length of carapax 7 millims., width 6.

Dredged in five fathoms, Mulege Bay, Gulf of California; also at Port Escondido. Several specimens.

The tubercles of the chelipeds are tipped with red (in spirits); and the bent tip of the left dactylus is bright red.

When the tomentosity of the carapax is rubbed off, the channel between the orbital and antero-lateral margins and the postgastric sulcus are distinct.

The long setæ which fringe the limbs are themselves regularly fringed along both sides with shorter setæ, appearing like a row of feathers, each with its shaft and pinnules.

Petrolisthes crenulatus, nov. sp.

Carapax covered with short plications, becoming rugæ toward the front and antero-lateral margins; gastric region elevated considerably above the frontal and orbital, the antero-lateral margin continuous, with four lobes, which bound the gastric region anteriorly.

Front deflected, consisting of the obtuse preorbital lobes and an obtuse-angled central lobe projecting slightly beyond them; postorbital tooth slightly marked, not spinous.

Cardiac region well defined by longitudinal sulci; two transverse sulci traceable across the entire carapax, the anterior enclosing the gastric region.

Chelipeds long and flattened. Meros with a blunt tooth at its anterior distal angle; carpus more than twice as long as wide, with four blunt teeth on its anterior margin, the two central largest; manus without spines; fingers of right and left chelipeds differing slightly, those of the right slightly gaping, and the right pollex with a blunt tooth.

Carpus and manus squamoso-granular, becoming granular on the manus; the upper surface of both joints tomentose toward the outer margin, especially near the elbow.

Ambulatory feet smooth, margined with long hairs anteriorly.

Length of carapax 10 millims., width 10.

Port Escondido, Gulf of California. A single specimen.

Petrolisthes occidentalis, Stimpson.

Petrolisthes occidentalis, Stimpson, Ann. Lyc. Nat. Hist. N. Y. vii. p. 73.

Stimpson says of this species that it is scarcely to be distinguished from *P. sexspinosus*, Gibbes; "but the carapax is slightly broader, the spines less prominent and acute, and the abdomen and feet more pubescent."

As he adds that the examination of a large number of specimens is necessary to establish these differences with certainty, it is evident that he did not feel sure of the specific distinctness of the form.

The characters given in the synopsis at the commencement of this article are taken from Gibbes's description of *P. sexspinosus* (Proc. Am. Assoc. 1850, p. 190).

I have not, to my knowledge, yet seen this form.

Petrolisthes armatus, Gibbes.

Petrolisthes armatus, Gibbes, Proc. Am. Assoc. 1850, p. 190.

Among the miscellanea from Lower California I find two specimens which I refer to this species.

The front is sinuous, the central portion arched forward, no preorbital spine; postorbital tooth obtuse; a little in the rear of the latter an acute spine, from which a not very prominent raised border runs backward around the carapax, which is punctate posteriorly, but with short rugosities anteriorly and on the margin.

Meros of chelipeds with a spine in front. Carpus almost three times as long as wide, armed with three large distant spines in front, and ten small ones along its raised outer margin; distal margin of carpus lobular; manus with a raised inner margin, the outer denticulate with a row of small spines, largest in the central portion of the palm, and passing into tubercles anteriorly and posteriorly; dactylus with a raised upper border; opposed edges of dactylus and pollex finely serrated. Meros of second pair with five or six small spines on anterior margin, that of third pair with six more prominent spines, that of fourth pair with four spines. A prominent spine at the posterior distal end of the meros of the second and third pairs, but none on the fourth pair. A long slender spine upon the posterior distal angle of the propodus of each of the ambulatory feet.

Ambulatory feet with long setæ, especially upon the three terminal joints, which show traces of bands of darker and lighter tints—red and straw-colour in the specimen (in alcohol).

The anterior border of the front is crenulate when viewed from above, and the antepenultimate joint of the antennal base has an anterior spinous lobe.

Stimpson mentions that most of his specimens had the outer edge of the hand smooth.

In one of the specimens there are two spines at the posterior distal extremity of the meros of third and fourth pairs; the carpus of the right cheliped has four spines in front, that of the left three; and of the denticulations on the posterior edge of the carpus only those at the distal extremity are developed into spines, four on the left and three on the right carpus.

Thus this species is subject to considerable variation.

My examples were from Mulege Bay, Gulf of California.

Petrolisthes Edwardsius, De Saussure.

As I have not seen De Saussure's description of this species (Rev. et Mag. de Zool. v. p. 366, pl. xi. fig. 3, *teste* Stimpson), and have only Stimpson's short description (Crust. & Echi. P. S. N. A. p. 40) to guide me, a description which will apply equally well to *P. armata*, I cannot be sure whether the two specimens I have before me (and I have seen others like them) are to be referred to *P. Edwardsius* or to a previously undescribed specific type. If the latter should prove to be the case, I would name the species *P. hirtispinosus*.

To facilitate identification I subjoin a description.

Entire surface of the carapax covered with short pubescence, beneath which the surface appears to be somewhat striated.

Gastric region elevated above the frontal and orbital, its raised anterior boundary passing into the lateral margin of the carapax above the level of the lateral spines.

Front triangular, depressed, projecting as much as that of *P. rupicola*; preorbital spine acute, separated from the central portion by a deep sinus; postorbital spine acute, with a broad base, above and behind which is a second, slender spine, merging into the rounded antero-lateral border.

A tooth on the penultimate, and a lobular tooth, ending in a spine, on the antepenultimate joint of the antennal base.

Distal border of the mandible with five or six small teeth.

Meros of chelipeds with a spine in front; carpus nearly three times as long as wide, with four or five large triangular teeth in front, ending in spines, followed by some spinose tubercles at distal end; central line of carpus elevated, posterior border with about nine small teeth; manus long and slender, an elevated line running longitudinally along it at about one third of its width from the raised interior margin; outer

margin denticulate, sometimes spinous (a young specimen has a row of six or seven spines).

Surface of chelipeds covered with squamose ridges with a crenulate edge, and thickly pubescent. The longitudinal ridge on the carpus is formed of prominent oblique squamæ, and that of the manus of a row of longitudinal crenulate squamose teeth, passing into a line of tubercles down the centre of the dactylus, which has a beaded upper margin. Fingers closely fitting, hooked at the tip. Chelipeds equal.

Meros of ambulatory feet with a row of spines, hidden among long setæ, on the anterior border, and a spine at distal end posteriorly on the second and third pairs; a slender spine at posterior distal end of propodus. Last three joints of these feet with long hairs and traces of colour (blue and red); meros pubescent.

Mulege Bay, Gulf of California.

Petrolisthes (Pisosoma) sinuimanus, nov. sp.

Carapax almost orbicular, somewhat convex, punctate, becoming granular on the lateral margins; front sinuous in three low lobes, the centre one very small, the preorbitals very long and low; sulci enclosing the gastric and cardiac regions distinct in young specimens, which have the carapax smooth.

Eyes very small; external antennæ very short, scarcely as long as the carapax.

Chelipeds equal, similar. Meros usually with a blunt lobe at its anterior distal end; carpus nearly twice as long as wide, usually with a single blunt tooth in the centre of its anterior margin; manus and dactylus forming an obtuse triangle, outer edge of manus and pollex serrated.

Upper surface of the carpus and manus with three longitudinal rolling ridges, divided by furrows equal to them in size, the entire upper surface of meros, carpus, and manus deeply punctate and granular; dactyli granular. Fingers hooked and crossing at the tip.

Ambulatory feet stout, punctate, the two anterior pairs with the posterior distal end of the carpus produced backwards.

Entire surface free from tomentosity or hairs, except two or three stout hairs on the underside of the dactyli of the ambulatory feet.

Length of carapax of largest specimen 5.5 millims., width of ditto 5.5.

Several specimens found under coral and stones at low tide at La Paz and Port Escondido, Gulf of California.

This species varies considerably: some few specimens are without a trace of the lobe upon the meros or of the tooth upon

the anterior margin of the carpus ; in others they are small, in others large and prominent. One specimen combines with the want of these teeth a carapax the surface of which is plicate upon the margins. The rolling ridges of the manus and carpus, and the deeply punctate surface of both, are constant characters.

This species is intermediate between *Petrolisthes* proper and Stimpson's *Pisosoma*, the carapax answering to the latter, the chelipeds approaching the former.

Petrolisthes (Pisosoma) gibbosicarpus, nov. sp.

Carapax smooth, somewhat convex, becoming slightly plicate on the postero-lateral margin, somewhat pentagonal, antero-lateral angles rounded ; gastric and cardiac regions defined by sulci ; front entire, sinuous ; postorbital tooth very slender and acute.

Flagella of antennæ more than twice the length of the carapax.

Chelipeds subequal ; meros with a laminate tooth at its anterior distal end above, and a spine on the underside distally ; carpus as broad as long, the anterior upper margin entire, laminate, the lamina broadest near the proximal end ; distal margin lobular ; manus flattened, narrower than carpus ; fingers gaping but slightly ; dactylus hooked at tip and crossing the tip of the pollex.

Surface of carpus and manus punctate above when viewed with a lens, the carpus rugulose on its outer margin.

Ambulatory feet set with long hairs, especially upon their anterior surface, manus somewhat punctate ; no hairs or pubescence on carapax or chelipeds.

Length and width of carapax equal, each measuring six millims. in the single female individual from which this species is described.

The hand and carpus show traces of decorative coloration, having a central area surrounded by a darker band.

The exact locality of my specimen is unknown ; but it certainly came from Lower California.

From the comparative stoutness of the chelipeds and the slight projection of the front, this species would appear to belong to Stimpson's genus *Pisosoma*.

Petrolisthes (Pisosoma) setimanus, nov. sp.

Carapax orbiculate, regions circumscribed by sulci, that behind the gastric region deepest. Postero-lateral regions crossed by rugæ.

Front entire, rounded, very slightly projecting in the centre ; postorbital tooth acute.

Eyes prominent, peduncle short.

Chelipeds short and stout ; meros with a crista or large tooth at its anterior distal end ; carpus but little longer than wide, upper surface laminate anteriorly, the thin portion with three teeth, the proximal largest, teeth crenulate along their edges ; upper surface of carpus, as well as the large teeth or crests, beset with granules.

Hands dissimilar, sometimes the right, sometimes the left being the larger. Palm of larger hand as broad as long, thick, covered with smooth circular tubercles ; pollex stout, short, curved ; dactylus almost cylindrical, punctate, longer than the pollex ; fingers gaping widely, but crossing at the tip.

Smaller hand with the fingers parallel and in contact throughout.

Anterior surface of carpus and manus of both chelipeds beset with hairs, longest on the margin.

Ambulatory feet fringed with scattered long hairs.

Length of carapax 9 millims., width 9.

Colour (in alcohol) bright red, deeper on the chelipeds.

Mulege Bay, San-José Island ; both in the Gulf of California.

The dactylus in the larger hand is inclined at an angle of about 40° with the anterior margin of the palm.

The specimens were taken in August or September ; and the females are loaded with ova.

The tubercles of the hand increase to teeth on the outer margin, which is thus serrated.

Petrolisthes (Pisosoma) biocellatus, nov. sp.

Carapax orbicular, convex, regions indistinct ; front entire, almost straight, postorbital spine acute.

Chelipeds short, stout, equal ; meros laminate at its distal anterior end ; carpus as broad as long, the upper anterior portion produced forwards as a thick lamina, divided into three low lobes ; manus stout, the palmar portion about equal in length to the carpus.

Surface of carapax and chelipeds smooth and shining, without hairs or setæ ; carpus and meros of chelipeds somewhat squamose when viewed with a lens.

Ambulatory feet beset with long setæ on their anterior surface.

Colour (in spirits) bright red, a round white spot on each shoulder ; tips of the fingers white.

The larger of the two specimens measures barely three centimetres in length.

Exact locality unknown: Lower California.

This pretty little species is a typical *Pisosoma*.

Pachycheles rudis, Stimpson.

Pachycheles rudis, Stimpson, Ann. Lyc. Nat. Hist. N. Y. 1862, vii. p. 76.

Stimpson states that this species was found "near San Francisco." I have not succeeded in finding it within the bay; but it may probably inhabit the rocky ocean-beach at no great distance from the Golden Gate.

The most southern locality I have on record for this species is Santa-Rosa Island (*W. G. W. Harford*); but among numerous bottles of material from Lower California I find one without a label which contains several young specimens.

In young individuals the tubercles or large granules of the manus and carpus are less prominent than in the adult.

The frontal region is densely pubescent, and the surface of the carapax striated toward the margins.

Pachycheles tuberculipes, nov. sp.

Carapax and limbs covered with dense and long pubescence, except in the central portions of the former; under surface smooth.

Front depressed; central portion triangular, deeply furrowed along the median line; preorbitals acute, deflected; carapax nearly smooth in the centre, tuberculate near and along the margin, somewhat convex.

Eye-peduncle fitting closely between the pre- and post-orbital teeth.

Antennæ distant from orbit; peduncles rough.

Chelipeds and ambulatory feet a mass of tubercles above; tubercles covered with granules, especially upon the manus. Chelipeds subequal.

Carpus with a tubercular tooth on the anterior margin at its superior proximal extremity; shorter than the meros when viewed from below.

Manus more than twice the length of the carpus; dactyli parallel, hooked at tip, with a smooth rounded ridge along the upperside.

Length of carapax about 3.5 millims., width about 3.5 millims.

Locality. La Paz, Gulf of California.

Five specimens of this singular form were found mixed with other species, in one case from La Paz, in others from other ports on the Gulf.

The thick pubescence and the large size and granulated surface of the tubercles on the upper surface of the chelipeds render it extremely difficult to make out details, while at the same time they give it an unmistakable aspect.

The large tubercles on carpus and manus, knobbed ambulatory feet, and equal-sized chelipeds at once distinguish this species from *P. rudis*.

Porcellana transversilineata, nov. sp.

Carapax elongate, length to width as one and a half to one; a pair of transverse prominences, almost amounting to teeth, just behind the frontal region, followed by several series of short rugæ forming interrupted transverse lines across the carapax; rugæ becoming longer and more distinct posteriorly, where they are frequently capped with a very short fringe of setæ directed forward.

Gastric region distinctly outlined. Lateral margins of carapax thin, crossed by regularly disposed short rugæ, and ending anteriorly in a sharp spine separated from the post-orbital spine by a deep notch.

Front tridentate; teeth long and acute, central one longest; lateral teeth slightly deflected.

Eyes scarcely visible above, hidden beneath the broad bases of the lateral spines; eye-peduncles long.

A flat spine below each antenna, at the side of the epistome, directed forwards and inwards.

Chelipeds short, subequal; meros and carpus about equal in length, and equal to the palmar portion of the manus; meros with a sharp spine at its anterior distal end; carpus with a smaller spine near the centre of its length; manus broader and thinner than the preceding joints, sharp-edged on both margins, beset with long setæ having a club-like tip; fingers compressed, parallel, obtusely serrated on their inner edge.

Ambulatory limbs short, subequal, stout, sparingly beset with setæ.

All the limbs crossed by short squamose rugæ, similar to those of the carapax.

Abdomen long, the first two joints visible above when it is folded below the sternum.

Boca de las Piedras, Sinaloa, 3 fms.; also Angeles Bay, west coast, Gulf of California, 5 fms.

Several specimens, taken in September; females with ova.

Length of carapax 6 millims., width of ditto 4.

Polyonyx nitidus, nov. sp.

Carapax entirely smooth and shining, convex, transversely

ovate, considerably broader than long, regions indistinct; front entire, straight; no post- or preorbital tooth.

Chelipeds smooth, shining, equal.

Meros stout, produced into a prominent lamina distally and anteriorly; carpus stout, about twice as long as wide, cylindrical except posteriorly, where there is a deep concavity for the reception of the posterior side of the manus; manus stout, cylindroidal, fringed anteriorly with long setæ; fingers short, abruptly hooked at tip, serrated, the dactylus longer than the pollex.

Ambulatory feet short, smooth, sparsely setose; meros somewhat compressed; dactyli multiunguiculate.

Length of carapax 7 millims., width 10.

Exact locality unknown; Lower California.

This specimen, found among some miscellanea of Mr. Fisher's collecting, evidently belongs to Stimpson's new genus *Polyonyx*, having the transversely ovate carapax, and entire front, which distinguish it from *Porcellanella* (White), and the multiunguiculate dactyli which characterize both genera.

The number of unguiculi does not appear to be equal on all the feet, as I counted four or five on the first ambulatory pair, and three only on the two succeeding pairs.

The first antennal joint is very long and the eyes minute, according to Stimpson's generic description. From *P. macrocheles*, Gibbes, it may be distinguished by the equal size of the chelipeds and the serrate edges of the fingers.

San Francisco, Sept. 5, 1878.

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XLIX.—*On the Reticularian and Radiolarian Rhizopoda (Foraminifera and Polycystina) of the North-Polar Expedition of 1875-76.* By HENRY B. BRADY, F.R.S.

[Plates XX. & XXI.]

FORAMINIFERA.

AMONGST the collections brought home by Capt. H. W. Feilden, R.A., the naturalist to the North-Polar Expedition which sailed in 1875 under the command of Capt. Sir G. Nares, R.N., were a number of gatherings of material which had been laid aside from time to time for examination with respect to Microzoa and Microphyta. There were in all some fifty or sixty packages; and after the Diatomaceæ had been determined, Capt. Feilden was kind enough to place them in my hands for the investigation of the Foraminifera and Polycystina. The material consisted for the most part of soundings; but there were a few samples of dust and dirt from discoloured ice, and of mud from beds of glacial deposit of greater or less age. The soundings were from depths of from 10 to 220 fathoms; and the quantity of each was comparatively small. The samples from mud-beds were larger, and yielded pretty good series of Foraminifera; but as they exhibit a fauna which is practically identical with that of the present sea-bottom at moderate depths in the same latitudes, they require no separate treatment. The dust from ice-hummocks and similar positions gave no Rhizopoda worth recording.

All the material was carefully washed to clear it of impalpable inorganic matter. This process seriously reduced many of the already small samples; and some of them left scarcely any residue for examination. Nevertheless of the fifty or sixty gatherings about forty yielded sufficient organic remains to give a general, though of course not an exhaustive, idea of the microzoic fauna of their respective localities. In some instances a number of the soundings were from points so near together and at depths so similar, that the results from several could be incorporated with advantage; but after condensation on this wise, and the omission of a few of those which gave obviously incomplete lists, there remains the groundwork for a fairly representative distribution-table comprising twenty-four stations. This must be regarded, under the circumstances, as very satisfactory. The primary object of the expedition was geographical rather than biological; there was no opportunity for dredging; and the chances of obtaining material in other ways were beset with difficulties hardly to be appreciated by those who, like myself, have been accustomed to collect in temperate regions.

The following is a list of the Stations arranged in order of latitude, beginning at the most southern point of the series. The geographical details, thanks to careful labelling, can be stated with much accuracy. The capital letters A to X refer to the heading of the columns in the accompanying Table. The area comprised in the Table may be divided into three sections. The first sixteen columns (A to P) refer to localities in Baffin's Bay and Smith Sound. These are separated by the whole length of Kennedy Channel (nearly two degrees) from Discovery Bay (Q), the only representative of the latitude of Hall Basin. Robeson Channel (nearly one degree) intervenes between this and the nearest of the seven remaining Stations.

A. Glacial mud, Tyndall Glacier, 27 fathoms, Sept. 12, 1876, situate in Bardin Bay, east side of Baffin's Bay, lat. 77° 15' N.

A little box of reddish clay with worn shell-fragments, containing relatively but few organisms; the Foraminifera belong chiefly to the genera *Verneuilina*, *Cassidulina*, *Truncatulina*, and *Nonionina*.

B. Off Cape Isabella, 220 fathoms, lat. 78° 20' N.

This is the deepest sounding containing Foraminifera; but it is richer in Diatomaceæ (notably *Coscinodiscus radiatus*) than in Rhizopoda. Of the latter, *Cassidulina*, *Truncatulina*, and *Nonionina* are again the most prominent types.

C. Off Cape Sabine, Smith Sound, 50 fathoms, lat. $78^{\circ} 44'$ N.

D. Off Brevoort Island, Smith Sound, 210 fathoms, lat. $78^{\circ} 44'$ N.

The former of these, from shallower water, contains but few species; the latter gives a tolerably rich list of Foraminifera—*Polystomella arctica* particularly fine and abundant, the genera *Lagena*, *Cassidulina*, *Truncatulina*, *Pulvinulina*, and *Nonionina* all well represented. There were in addition a few Ostracoda*.

E. Off Cape Victoria, Bache Island, 35 fathoms, lat. $79^{\circ} 14'$ N.

The genus *Truncatulina* by far the most abundant, associated with *Nonionina*, *Polystomella*, and other shallow-water types. Contained also Ostracoda of five species and a few *Coscinodisci*.

F. Between Walrus Shoal and Victoria Head, Sept. 8, 1876, 57 fathoms, lat. $79^{\circ} 26'$ N.

A poor lot, containing little beyond *Cassidulina*, *Nonionina*, and the weaker forms of *Polystomella*, with one or two Radiolaria. The only specimen of *Pulvinulina Micheliniana*, a common surface form in the North Atlantic, found in the entire collection, was in this material.

G. and H. Franklin-Pierce Bay, lat. $79^{\circ} 28'$ N.

The former (G) refers to two soundings, in 13 fathoms and 15 fathoms respectively; the latter (H) to two in 46 fathoms. The contents of all four were much alike, sandy mud with small worn stones; those from the greatest depth contained the largest variety of organisms. The salient types of Foraminifera in all are *Lituola*, *Truncatulina*, and *Polystomella*. The shallow-water material furnished the only specimens found of the genus *Discorbina*. It contained in addition a number of diatoms, which my friend Mr. F. Kitton, of Norwich, tells me are as follows:—*Triceratium arcticum*; *Biddulphia*, sp.; *Rhabdonema Crozieri*; *Grammatophora marina*; and *Actinoptychus undulatus*. A few valves of Ostracoda were also met with.

I. Allman Bay, Sept. 14, 1876, 25 fathoms, lat. $79^{\circ} 30'$ N.

The Bay between Cape Hawks and Cape d'Urville.

A tube full of sand and stones, but rich in Foraminifera. The genus *Lagena* in considerable variety, with *Polymorphina*,

* The Ostracoda were carefully preserved throughout, and form the subject of a separate notice by my brother, Dr. G. S. Brady.

Cassidulina, *Pulvinulina*, and *Nonionina* as its prominent associates.

J, K, and L. Dobbin Bay, Aug. 28 to Sept. 1, 1876, lat. 79° 35' N.

The column J includes three soundings, namely in 45, 46, and 47 fathoms, whilst K and L are from 113 and 125 fathoms respectively. The muddy material obtained in 46 fathoms contained the largest number of forms; in that from the greatest depth organisms of all sorts are rare. The leading types of Foraminifera are *Cassidulina*, *Pulvinulina*, and *Polystomella*.

M and N. Off Hayes Point, Aug. 18 and 19, 1876, lat. 79° 42' N.

Two soundings, the one in 22, the other in 35 fathoms, containing a few Diatomaceæ and Ostracoda and a sprinkling only of Rhizopoda, the latter chiefly *Cassidulina* and *Truncatulina*, with *Virgulina*, *Pulvinulina*, and *Polystomella* in smaller numbers.

O and P. Off Cape Frazer, Aug. 24th, 1876, lat. 79° 45' N.

The column marked O is compiled from a single sounding at 50 fathoms; that headed P is from three soundings, all at a depth of 80 fathoms. The latter taken together yield by far the best representative list of the whole series, comprising in all thirty-three species of Foraminifera. The most characteristic amongst them are *Polystomella arctica*, which is of large size and abundant, and the hitherto undescribed type *Hyperammia*. Almost all the genera contained in the other lists are present to a greater or less extent, the most important exception being *Polymorphina*. The same locality also gave the richest list of Ostracoda—eleven species, one of which is new to science.

Q. Discovery Bay, lat. 81° 41' N.

Comprises two samples—one from 23 fathoms, the other from 25 fathoms. Rhizopoda rare and minute, chiefly *Cassidulina*, other genera being represented by very poor specimens.

R. Fiord Valley, near Lincoln Bay, lat. 82° 8' N.

Mud taken from between the valves of shells; yielded little beyond *Cassidulina* and the weak varieties of *Polystomella*. The Ostracoda were of more importance and embraced one new species.

S. Mud from ravine north of Repulse Bay, lat. 82° 10' N.

A little sandy glacial mud from Hall's Land, with the

label "brought by Mr. Egerton, April 1876." It contained but few specimens, and these of only four species. Though manifestly insufficient to show the extent of the fauna, they have been allowed a column in the Table as representatives of a region somewhat separated from the rest. Ostracoda were present, but in very small numbers.

T. Winter quarters of the 'Alert,' 1875-6, 6 fathoms, lat. 82° 27' N.

Four tubes containing dried mud. Foraminifera chiefly of the genera *Globigerina*, *Cassidulina*, *Nonionina*, and *Polystomella*. Some of the tubes gave also a few Diatomaceæ (*Triceratium arcticum*) and occasional valves of Ostracoda.

U. Mud-beds, 150 feet elevation, lat. 82° 27' N.

This material was found to be almost devoid of organic remains of any sort; the few specimens of Foraminifera were of quite the commonest species.

V. Floeberg Beach, July 1876, lat. 82° 29' N.

A small tube of sand from the shore, and a pill-box with mud and stones from a depth of 10 fathoms, only furnished together what appears to be an incomplete list; and the specimens were all very small. There were a few Ostracoda also present.

W. Cane Ravine, June 1876, lat. 82° 33' N.

A lot of finely divided silt, taken out of a specimen of *Astarte borealis*, from mud-beds 100 feet above the sea-level, in Grinnell Land; containing small examples of a few of the common arctic types of Foraminifera and Ostracoda.

X. Sounding, May 11, 1876, 72 fathoms, lat. 83° 19' N.

The most interesting sounding in the entire collection, not merely as being the most northerly, but also, considering the minute quantity that could be obtained for examination (only a few grains altogether), as presenting the most varied range of Microzoa. It consisted of fine soft mud containing Diatomaceæ (*Coscinodiscus radiatus*), Radiolaria in greater variety than any other sounding, and Foraminifera of no less than eleven genera, the most abundant of the latter being a dwarf variety of *Globigerina*.

In tracing on the map the area represented by this collection, and comparing it with that covered by previous researches, it becomes manifest that the ground is altogether new. Our present knowledge of arctic Rhizopoda is chiefly derived from the labours of Profs. W. K. Parker and T. Rupert Jones, and of the Rev. A. M. Norman. The memoir of Messrs. Parker and

Jones, in the 'Philosophical Transactions' for 1865, forms the text-book of the subject. It contains the results of the examination of the soundings taken by Sir E. Parry in Baffin's Bay, between latitudes $74^{\circ} 45'$ and $76^{\circ} 30' N.$; of those of Dr. Sutherland off the Hunde Islands, on the west coast of Greenland, in lat. $68^{\circ} 50' N.$; and of dredgings made by Mr. M'Andrew off the coast of Norway, between lat. 65° and $71^{\circ} N.$ Mr. Norman's material consisted of dredgings brought home by Dr. J. Gwyn Jeffreys from his cruise in the 'Valorous,' the vessel, it will be remembered, which sailed in company with the 'Alert' and 'Discovery,' as far as Disco Island, on their northward voyage. The record of Mr. Norman's observations on the Rhizopoda, which, so far as they affect our present purpose, refer to an area lying between about lat. 59° and lat. $70^{\circ} N.$, forms one section of the general scientific report submitted to the Royal Society. A notice by Dr. Carpenter of a few of the larger forms appeared at the same time.

Messrs. Parker and Jones's memoir is accompanied by a series of elaborate distribution-tables, one of which is devoted to the Arctic fauna. Of the twenty localities it comprises, seven belong to the group of soundings from Baffin's Bay, five to the Hunde Islands, and eight to the Norwegian coast. In all seventy-five species of Foraminifera are enumerated; and of these twenty appear in the Norwegian list only. A condensed statement of the results embodied in Messrs. Parker and Jones's Table will be found in the three columns (*a, b, c*) appended to that which accompanies the present paper. A ready means of comparison is thereby afforded, and the subject need not, therefore, be further dwelt upon.

The 'Valorous' report cannot, unfortunately, be treated in the same way, as it contains no detailed lists of the Foraminifera. I propose, therefore, in order to complete the summary of what has been hitherto written on the subject, to cull from the Rev. A. M. Norman's paper (Proc. Roy. Soc. vol. xxv. pp. 207-213) such particulars as he gives relative to the distribution of species in those localities that come within the sphere of our present inquiry. Having had the opportunity of looking over the fine collection of Foraminifera obtained from the 'Valorous' material, I may be permitted to express my regret that circumstances have hitherto prevented Mr. Norman from giving his results to the world. They are of great interest and cost much labour; and the details would have been a valuable contribution to the literature of the Rhizopoda. Four of these dredgings were from points within the Arctic Circle; and two others, from the Stations num-

bered 8 and 9 respectively, though not strictly arctic in latitude, pertain to an adjacent and much richer zoological area, and are within Davis Straits, which may be regarded as a sort of natural boundary. The following notes are abstracted from Mr. Norman's summary.

HOLSTEINBORG HARBOUR (lat. $66^{\circ} 40'$ N.), 7-35 fathoms.

The more remarkable Foraminifera were:—*Trochammina gordialis*, J. & P.; *Lituola canariensis*, D'Orb.; *Textularia biformis*, P. & J.; and *Bolivina punctata*, D'Orb.

GODHAVN HARBOUR, DISCO (lat. $69^{\circ} 10'$ N.), 5-20 fathoms.

Thirty-six species identified, amongst them:—*Dentalina consobrina*, D'Orb. (fide P. & J.), *Polymorphina burdigalensis*, D'Orb.; *Pullenia sphaeroides*, D'Orb.; *Verneuilina polystropha*, Reuss; *Cassidulina obtusa*, D'Orb.; *Pulvinulina Karsteni*, Reuss; and *Discorbina obtusa*, D'Orb.

LIEVELY HARBOUR, DISCO (lat. 70° N.*), 5-20 fathoms.

The Foraminifera exhibited a marked parallelism with those recorded by Mr. G. M. Dawson from Gaspé Bay†, in the Gulf of St. Lawrence. Twenty-eight species were noted, including:—*Rhabdopleura abyssorum*, Parker; *Lituola cassis*, Parker; *Nonionina labradorica*, Parker; and *Bulimina pyrula*, D'Orb.

STATION No. 5. Lat. $66^{\circ} 59'$ N., long. $55^{\circ} 27'$ W., 57 fathoms.

Thirty-five Foraminifera observed, ten belonging to the genus *Lagena*. The list contains, amongst others:—*Lagena striatopunctata*, P. & J.; *Lituola globigeriniformis*, P. & J.; *Cyclammina cancellata*, H. B. Brady, MS.; and *Bulimina elegantissima*, D'Orb.

STATION No. 8. Lat. $62^{\circ} 6'$ N., long. $55^{\circ} 56'$ W., 1350 fathoms.

Contained many of the more common Foraminifera. The following are noted:—*Nodosaria Schlichtii*, Reuss; *Orbitolites tenuissimus*, Carpenter; *Pullenia quinqueloba*, Reuss; and *Lituola nautiloidea*, Lamk.

STATION No. 9. Lat. $59^{\circ} 10'$ N., long. $50^{\circ} 25'$ W., 1750 fathoms.

Remarkable for the abundance and variety of arenaceous

* The latitudes of Holsteinborg, Godhavn, and Lievely Harbours are not given in the Report, and the last of the three does not appear in any map I have access to; but, for the purpose of comparison with the range of the other localities, the figures stated are near enough.

† It must be remembered, nevertheless, that Gaspé Bay is in lat. 48° to 49° N., or fully a degree south of the coast of Cornwall, though more or less Arctic in climatal conditions.

types, e. g. *Rhabdammina*, *Pilulina*, most of the various forms described as *Lituolæ* by Dr. Carpenter, and *Astrorhiza catenata*, Norman. In addition to these, *Cristellaria obvelata*, Reuss, *Orbulina neojurensis*, Karrer, and the dwarf variety of *Globigerina bulloides*, alluded to on a later page of the present paper, were also found.

To turn now to the more strictly zoological portion of the subject. An examination of the accompanying Distribution-Table, still more the inspection of the mounted specimens, brings into relief certain characteristics of the Polar foraminiferal fauna. Some remarks will presently be made on the individual species where they exhibit any special or noteworthy features; but attention may be drawn at the outset to one or two facts of more general import. There are about half a dozen species that may be regarded as essential constituents of the microzoic fauna of these high latitudes, having been found at almost every depth at which the floor of the sea has been examined. They are as follows—*Globigerina bulloides* (a dwarf variety), *Cassidulina lævigata* and *C. crassa*, *Truncatulina lobatula*, *Pulvinulina Karsteni*, and *Polystomella striatopunctata*. They are usually accompanied by one or two forms of *Nonionina*, varying according to depth and other circumstances, and, if the sea-bottom be composed of rough sand or gravel, by *Polystomella arctica*. Other species occur in every sample of mud or sand wherever obtained; but it is not too much to say that those above enumerated constitute ninety-five per cent. of the entire collection made from these soundings. The constant occurrence of *Cassidulina lævigata*, of full size and well-grown, even when the other Foraminifera accompanying it were poor, starved specimens, and the presence of *Pulvinulina Karsteni* in almost every dredging to the practical exclusion of all other species of the same genus, are points of considerable significance. The almost complete absence of the Milioline genera (for the occurrence of a single, minute, thin-shelled specimen here and there in a few of the soundings amounts to absence in such a case) is an unexpected feature. In dredgings at similar depths but little to the south of those under consideration the simple porcellaneous forms are comparatively common; and their area of distribution is otherwise world-wide; yet it is hardly too much to say that no approach to a full-sized mature specimen of any of the modifications of the Milioline type has been met with in the North-Polar material.

One or two of the species are undescribed hitherto; and a few others present characters somewhat modified by their

boreal habitat. The following notes refer to some of these; the numbers prefixed correspond with those employed in the Table. The new forms and the more interesting varieties are figured in Plates XX. and XXI.; for the rest, nearly all the species are well illustrated in Messrs. Parker and Jones's memoir before referred to, or in Prof. Williamson's 'Recent Foraminifera of Great Britain.'

9. *Lituola glomerata*, nov. (Pl. XX. fig. 1, *a-c*.)

Characters. Test free, arenaceous, thin-walled, non-labyrinthic; spiral in arrangement, subglobular in form, often somewhat lengthened in the direction of the axis; usually more or less unsymmetrical. Segments few, three or four in each convolution, long, narrow. Sutures but little excavated except at the ends. Aperture at the inner margin of the terminal chamber, near the exterior of the corresponding segment of the previous convolution, simple, often obscure. Diameter of the test seldom more than $\frac{1}{100}$ inch (0.25 millim.).

This, which is perhaps the most minute of the segmented Lituolida, is an obscure and difficult form to treat. The septation is often imperfect and sometimes cannot be traced on the exterior. The drawings (Pl. XX. fig. 1, *a-c*) are from unusually good specimens, and they are sufficiently characteristic. When the Lituoline genera come to be rearranged in the light of the material which now exists for their more extended and accurate study, it is possible that this, in common with some other of our northern species, may find its place in Reuss's genus *Haplophragmium*; but its nearest allies are forms best recognized at present under the generic term *Lituola*. In distribution *Lituola glomerata* is by no means confined to the arctic seas, but has been met with in the 'Challenger' dredgings from many parts of the world.

10. *Hyperammia elongata*, nov. gen. et sp.
(Pl. XX. fig. 2, *a, b*.)

Characters. Test arenaceous, in the form of a straight or nearly straight tapering tube, the wide end closed and rounded, the open narrow end constituting the general aperture. Exterior sandy and rough, interior smooth. Length (of the Arctic specimens) about $\frac{1}{10}$ inch (2.5 millims.).

This is one of the many arenaceous types brought home in 1869 by the naturalists in charge of the first cruise of the 'Porcupine;' but it has not hitherto, so far as I am aware, received a name. Its club-like or, still more, its pestle-like contour and sandy texture, suggest the term *Hyperam-*

*mina**. The polar specimens are very small when compared with those from the North Atlantic, or with those from many of the 'Challenger' stations—examples considerably more than half an inch (15 or 16 millims.) being not unfrequent in other localities.

14. *Lagena apiculata*, Reuss.

The somewhat compressed as well as the globose forms are included under this name.

17. *Lagena striatopunctata*, Parker & Jones.
(Pl. XX. fig. 3.)

A few specimens similar in character to those figured by Messrs. Parker and Jones were met with in two of the deeper soundings.

18. *Lagena Feildeniana*, nov. (Pl. XX. fig. 4.)

Characters. Test subglobular, pyriform, with surface-ornamentation consisting of a few stout longitudinal costæ alternating at regular distances with longitudinal rows of large perforations. Longer diameter about $\frac{7}{10}$ inch (0.37 millim.).

A very pretty little shell, with somewhat striking superficial ornament. It bears considerable resemblance to two other costato-perforate species, namely *Lagena striatopunctata*, P. & J., and *L. Howchiniana*, Brady. The former of these has a double row of minute pores bordering each riblet (Pl. XX. fig. 3); the latter, which is a Carboniferous species, has a single row of orifices down the top of each ridge; whilst *L. Feildeniana* is distinguished by stout entire costæ with a single series of large pores in the furrows between them. As this particular varietal form does not appear to have been hitherto observed or described, it may very properly be associated by name with the naturalist to whom we owe the North-Polar collections.

Hab. Off Cape Frazer, 80 fathoms.

19. *Lagena caudata*, D'Orbigny.

A single entosolenian specimen, not unlike that figured by Williamson as *Entosolenia globosa*, var. *lineata*, Rec. For. Gt. Br. pl. i. fig. 17.

22. *Glandulina lævigata*, D'Orbigny.

From 80 fathoms off Cape Frazer, very rare; an elongate variety resembling *G. gracilis* of Reuss, though not quite so attenuated and sharp-pointed.

* *ὑπερος* (a pestle), *ἄμμος* (sand).

25. *Cristellaria rotulata*, Lamarck.

Also one or two specimens approaching *C. crepidula* in contour.

26. *Polymorphina lactea*, Walker & Jacob.

Both typical pyriform specimens, and the compressed modification known as *P. lactea*, var. *amygdaloides*, Reuss.

29. *Polymorphina acuminata*, D'Orbigny. (Pl. XX. fig. 5, a, b.)

30. *Polymorphina rotundata*, Bornemann. (Pl. XX. fig. 6, a, b.)

Two interesting and somewhat rare forms, sufficiently illustrated by the figures. It is necessary, however, to bear in mind that the successive modifications of the genus *Polymorphina*, though generally pretty easily recognized, are of little more than varietal significance.

32. *Globigerina bulloides*, D'Orbigny, var.
(Pl. XXI. fig. 10, a, b, c.)

Occasional specimens of the genus *Globigerina* occurred in most of the soundings; in one only were they present in sufficient abundance to constitute what we are accustomed to speak of as a *Globigerina*-ooze, namely in that from the most northerly point attained by the Expedition. The specimens differ considerably from the typical form—so much so that they can hardly be associated with it except as a variety. The shells are very small, compactly made, and nearly spherical; the individual segments are scarcely ventricose, and do not exhibit the globular contour that we are accustomed to regard as characteristic of the genus, nor do they open into a central or umbilical vestibule, but communicate directly with each other. The general aperture forms a semicircular or crescentic opening at the inferior margin of the terminal chamber. The Rev. A. M. Norman probably alludes to the same modification of the type in his description of specimens from a depth of 1750 fathoms in lat. 59° 10' N., long. 50° 25' W., one of the 'Valorous' stations just within Davis Straits*.

34. *Uvigerina pygmæa*, D'Orbigny, var.
(Pl. XX. fig. 7, a, b.)

The *Uvigerina*, a very few specimens of which were found in several of the soundings, are uniform in their characters and

* Proc. Roy. Soc. vol. xxv. p. 212.

contour. They are minute, thin-shelled, and obscurely triangular; but the segments are more inflated than in the *Uvigerina angulosa* of Williamson, and the surface ornamentation is very partially distributed. They differ almost as much from the typical *U. pygmæa**; but the points of divergence are such as may and probably have been brought about by the different life-conditions of a polar climate. Such specimens may be accepted as representing a starved or impoverished variety of the typical form rather than a distinct species.

38. *Bulimina elegantissima*, D'Orbigny. (Pl. XXI. fig. 12.)

Very rare, and not of the precise contour by which the species is usually recognized: the segments are similarly arranged; but they are relatively shorter, and there are fewer in each convolution, as indicated in the figure.

41. *Textularia biformis*, Parker & Jones. (Pl. XX. fig. 8.)

A very minute, thin-shelled arenaceous species. Messrs. Parker and Jones's figures are on somewhat too small a scale to show the conformation of the test quite distinctly. The largest of the Polar specimens is but little over $\frac{1}{10}$ inch (0·37 millim.) in length.

42. *Verneuilina polystropha*, Reuss. (Pl. XX. fig. 9, a-c.)

Small specimens of this arenaceous triserial Textularian are common in one or two of the localities. They are often of the slender, more elegant form delineated in fig. 9, a.

45. *Pulvinulina Karsteni*, Reuss. (Pl. XXI. fig. 11, a-c.)

Over extensive areas, in almost every portion of the globe, the floor of the ocean is largely composed of the shells of Foraminifera belonging to two genera, *Globigerina* and *Pulvinulina*; but for the most part these are merely the dead skeletons of pelagic species which, when living, inhabit a layer of water that, comparatively speaking, may be regarded as superficial; but it is far otherwise in these high latitudes. A single chance specimen of *Pulvinulina Micheliniana* is the only representative of the pelagic section of the genus found in the entire collection of soundings; whilst *Pulvinulina Karsteni*, one of the many species that, so far as we know, live on the sea-bottom, is present everywhere, and the size and condition of the specimens indicate that it is at home in these northern regions.

* Compare Williamson's figures, Rec. For. Gt. Br. pl. 5. figs. 138-140, with fig. 7, a, b, of the present paper.

53. *Polystomella arctica*, Parker & Jones.
(Pl. XXI. fig. 13, *a-d*.)

An essentially boreal species, its distribution probably not extending further south than Shetland. It is a large, coarse, thick-shelled modification of the type, most nearly related to *P. striatopunctata*. There are, however, certain structural peculiarities observable in mature specimens, the most important of which is the duplication of the sutural apertures. Instead of the single line of orifices immediately over each septum, there are frequently two parallel rows, which, if the sutures are marked externally by raised bands of exogenous deposit, appear one on each side of the limbation. From the exterior it appears as though the two rows of pores opened respectively into the two adjacent chambers; but with a little care sections may be made (fig. 13, *d*) showing clearly that this is not the case, but that the double tubulation is the result of the lengthening and bifurcation of what was originally a simple orifice. The horizontal section of the entire shell (fig. 13, *c*) shows its general structure. The laminated thickening appears to be confined to the last convolution, and to be caused by the chamber-wall of some of the segments being extended over that of the previously formed chambers, as in the Nummulite. The investment of the later chambers is therefore thinner than that of those preceding them, the last formed being the thinnest.

The typical *Polystomella crispa*, so common in the shallow water of temperate latitudes, does not appear at all in the material from these polar localities. It seems to be replaced by *P. arctica*, with *P. striatopunctata* in still larger numbers; and these pass by insensible gradations into the various forms of *Nonionina*.

RADIOLARIA.

Here and there in the finer portions of some of the soundings the siliceous tests of Radiolaria were observed; but at one station only, and that the most northerly of all, were they met with in any abundance. In most cases there was no great difficulty in assigning the various forms which were obtained to their generic types; but it was found impossible to determine the species satisfactorily from published authorities. Under these circumstances, the natural course to pursue was to forward the mountings to Prof. Haeckel, of Jena, for his opinion on the more doubtful specimens. The learned Pro-

fessor has been kind enough to examine the mountings; and his remarks upon them contain much of interest. He states that the species are, as far as they go, exactly identical with those he finds in the 'Challenger' soundings from the Stations numbered 268 to 274 in Sir Wyville Thomson's printed list—that is to say, with the particular species which are found at the sea-bottom in the middle of the Pacific, from about 8° N. of the equator to 8° S. of the same, at depths of 2400 to 2900 fathoms. Prof. Haeckel confirms the view which I had already arrived at, that, until we have the wider basis for accurate nomenclature which the publication of the 'Challenger' Radiolaria will afford, it is better to give nothing more than an enumeration of the genera observed.

There has been no previous record of Arctic Radiolaria, except in the tabular statements which accompany the Rev. A. M. Norman's paper (*op. cit.* xxv. pp. 204, 205). In these Tables eight species of Polycystina are set down as occurring on the west coast of Greenland and in Davis Straits; but I gather from the author that the entry is only intended to convey the fact of this number of distinct forms being observed, and that no determination of genera or species was attempted.

The following notes represent the distribution of the group so far as revealed by the polar soundings:—

AA. Off Cape Dudley Digges, July 26, 1875, 260 fathoms, lat. 76° 7' N.

This sounding is from a point in Baffin's Bay somewhat south of the rest. The material contained no Foraminifera worth recording; and therefore the locality was not included in the Table. The Radiolaria were few in number, and belonged to the genera *Spongodiscus* and *Spongotrochus*.

B. Off Cape Isabella, 220 fathoms, lat. 78° 20' N.

Contained more than one species of *Spongotrochus*.

F. Between Walrus Shoal and Victoria Head, Sept. 8, 1876, 57 fathoms, lat. 79° 26' N.

Five genera of Radiolaria represented, viz. *Haliomma*, *Tetrapyle*, *Heliodiscus*, *Spongaster*, and *Euchitonina*.

J and K. Dobbin Bay, 47 fathoms and 113 fathoms, lat. 79° 35' N.

The only genera noticed were *Trematodiscus* and *Spongotrochus*.

X. Sounding, May 11, 1876, 72 fathoms, lat. 83° 19' N.

The most northerly point attained. The little tube full of

mud which was secured yielded species of the following genera—*Dictyopodium*, *Haliomma*, *Tetrapyle*, *Heliodiscus*, *Actinomma*, *Spongotrochus*, *Spongaster*, and *Euchitonia*.

Thus in all there are ten genera of Radiolaria, eight of which exist in the highest latitudes that have yet been reached.

We are now in a position to inquire what actual service to biological science, or rather to that small section of it which has been considered in the foregoing pages, has been rendered by the North-Polar Expedition of 1875-76.

Nothing need be added to what has already been said about the Radiolaria. With respect to the Foraminifera it has been seen that previous researches had rendered account of the Arctic fauna as far north as lat. $76^{\circ} 30'$ —that is, to within $13^{\circ} 30'$ of the North Pole. To this record we are now able to add three further instalments, namely, the group of soundings in Smith Sound and the north of Baffin's Bay, a single one in Hall Basin, and, lastly, a series to the north of Robeson Channel. These extend our knowledge of the sea-bottom to lat. $83^{\circ} 19' N.$, a distance of $6^{\circ} 49'$ —in other words, over more than half the interval between the most northerly point of previous researches and the actual North Pole. From a zoological point of view the result is not less gratifying. Sir E. Parry's soundings in Baffin's Bay, which, taken together, furnish the northernmost section of Messrs. Parker and Jones's Table, yielded seventeen species of Foraminifera. All but three of these have been found in the material brought by Captain Feilden; but they form only a small part of the catalogue of fifty-three species which appear in our Table. Setting aside the Norwegian lists given by the same authors, as representing a fauna more or less influenced by the warm current of the Gulf-stream, the Hunde-Island and Baffin's-Bay columns give an aggregate of fifty-five species, or only two in excess of the total now recorded. The facts which have been elicited therefore appear to indicate that there is no very striking diminution in the number and variety of the Rhizopoda as we approach the North Pole.

EXPLANATION OF THE PLATES.

PLATE XX.

Fig. 1. Lituola glomerata, n. sp., magnified 100 diam. : *a* and *b*, periphero-lateral aspect, front and back; *c*, end view.

Fig. 2, a, b. Hyperammia elongata, n. gen. et sp., magn. 40 diam.

Fig. 3. Lagena striatopunctata, Parker & Jones, magn. 75 diam.

- Fig. 4. *Lagena Feildeniana*, n. sp., magn. 75 diam.
 Fig. 5. *Polymorphina acuminata*, D'Orbigny, magn. 75 diam.: *a*, periphero-lateral aspect; *b*, end view.
 Fig. 6. *Polymorphina rotundata*, Bornemann, magn. 65 diam.: *a*, periphero-lateral aspect; *b*, end view.
 Fig. 7. *Uvigerina pygmæa*, D'Orbigny, var., magn. 90 diam.
 Fig. 8. *Textularia biformis*, Parker & Jones, magn. 90 diam.
 Fig. 9. *Verneuilina polystropha*, Reuss, magn. 90 diam.

PLATE XXI.

- Fig. 10. *Globigerina bulloides*, D'Orbigny, arctic variety, magn. 100 diam.: *a*, superior or spiral face; *b*, inferior aspect; *c*, peripheral aspect.
 Fig. 11. *Pulvinulina Karsteni*, Reuss, magn. 50 diam.: *a*, superior; *b*, inferior; *c*, peripheral aspect.
 Fig. 12. *Bulimina elegantissima*, D'Orbigny, var., magn. 90 diam.
 Fig. 13. *Polystomella arctica*, Parker & Jones: *a*, lateral, *b*, peripheral aspect, magnified 30 diam.; *c*, horizontal section, showing the laminated thickening of the shell-wall and its minute tubulation, magn. 40 diam.; *d*, horizontal section of part of the outer convolution, more highly magnified, showing the bifurcation of the sutural orifices, magn. 100 diam.

L.—*Descriptions of new Species of Heterocera from Japan.*—
 Part III. *Geometrites*. By ARTHUR G. BUTLER, F.L.S.,
 F.Z.S., &c.

[Continued from p. 406.]

Zerenidæ.

ABRAXAS, Leach.

196. *Abraxas conspurcata*, n. sp.

Wings white, black at the base; black discocellular blotches, two parallel discal series of subconfluent black blotches, between which runs an orange line; a confluent series of marginal black blotches: primaries with the base orange-streaked; a central costal black patch confluent with the discocellular blotch; two subbasal black blotches. Body orange, spotted with black; the head and thorax black, but the back of the collar and tegulæ orange. Expanse 1 inch 7 lines.

Yokohama (*Jonas*).

This species is much like some extreme heavily spotted varieties of *A. grossulariata*; but it may be readily distinguished from them all by the two discal series of large spots or blotches being nearer to the outer margin and complete in the secondaries as well as in the primaries, also in the secondaries being broadly black at the base.

197. *Abraxas miranda*, n. sp.

Allied to *A. leopardinata* from India, but larger; the primaries with broader and darker basal and internal patches; the costa blotched with grey throughout, the patch over the end of the cell much larger and confluent with the costal patch; the transverse grey belt below it placed nearer to the middle of the wing and *touching the dark internal patch*; two confused parallel discal series of grey blotches; a number of small grey spots forming two imperfect parallel series on externo-discal area: the secondaries with a *complete* grey belt across the cell; two somewhat confused discal series of grey blotches terminating in the usual dark internal patch; external area spotted with grey; marginal blotches partially *confluent*. Body similar. Expanse, ♂ 2 inches, ♀ 2 inches 4 lines.

Yokohama (*Jonas*).

198. *Abraxas placida*, n. sp.

White, with ochraceous body; wings with ochreous outer border and black-spotted orange fringe; an externo-discal series of black spots, imperfect in secondaries; base ochraceous, spotted with black: primaries with three subbasal blackish spots; an irregular central band formed of blackish blotches; two black costal spots near apex: secondaries with a central irregular band formed of blackish lines: shoulders and palpi blackish. Wings below nearly as above. Expanse 1 inch 5 lines.

Hakodaté (*Whitely*).

EUCHERA, Hübner.

199. *Euchera Agnes*, n. sp.

Wings white, with broad smoky-grey outer border, crossed by a more or less confluent series of white or whitish lunules parallel to the outer margin: primaries sometimes with the lunules very indistinct; base and a subcostal streak ochreous; basal area covered by about ten grey spots in three series; a central broad belt, externally angulated, composed of grey blotches: secondaries with a grey belt almost surrounding the discoidal cell: body ochreous. Wings below white, the markings almost as above, but blackish and narrower; white lunules confluent and well-defined on all the wings, blackish discocellular spots: primaries only ochreous on the costal border, the basal area only marked with one large blackish.

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blotch: body below white; abdomen belted with grey.
Expanse 2 inches 6–8 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

DEROCA, Walker.

200. *Deroca phasma*, n. sp.

♂. Hyaline, snow-white: primaries with three grey spots across the basal half of the costa, a fourth above the end of the cell, and a larger spot at the end of the cell; a large apical patch crossed by a trifid white patch, and a similar smaller patch at the external angle grey: antennæ with grey pectinations; abdomen grey, crossed by white segmental lines. Wings below nearly as above, but the grey markings darker and the costal spots on the basal half confluent; body below cream-coloured. Expanse 1 inch 4 lines.

♀. Larger, iridescent, and with much paler markings. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

LOMASPILIS, Hübner.

201. *Lomaspilis opis*, n. sp.

Wings creamy white: primaries with the basal fourth, three large blotches across the centre (the two uppermost confluent), the apex, outer margin, and external angle pale purplish brown: secondaries with three blotches across the centre, the apex, a subapical marginal spot, outer margin, and anal angle pale purplish brown. Body brown, legs testaceous. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

Nearly allied to the European *L. marginata*, but differing in the brown blotches across the centre of the wings.

Ligiidæ.

PACHYLIGIA, n. gen.

Allied to *Ligia*, with similar antennæ and neuration; the body much more robust, broader; the primaries much wider, with more strongly defined external angle; fringe shorter. Type *P. dolosa*.

202. *Pachyligia dolosa*, n. sp.

Primaries fuliginous brown, varied with bronzy brown; base longitudinally streaked with black; two irregularly sinuated central black lines, and between them an irregular

blackish stripe; upper discocellular black; outer border bronzy, with undulated inner edge; a submarginal series of dark brown spots; margin undulated; fringe pale at base: secondaries sordid white, with pinky brown outer border and darker brown fringe; upper discocellular black: head and thorax brown; abdomen testaceous; antennæ testaceous. Primaries below greyish, with testaceous costa; outer border slightly paler; a black discocellular dot: secondaries whity brown, with testaceous costa; fringe and an anal streak dusky; a large black discocellular spot. Expanse 1 inch 11 lines.

Yokohama (*Jonas*).

203. *Pachyligia modesta*, n. sp.

♂. Primaries silvery whitish, crossed by two slender irregularly dentate and crinkled blackish lines; a third paler line limiting the outer border: secondaries slightly browner in tint than the primaries, crossed in the middle by an irregularly sinuated grey line; margin slenderly blackish; fringe silvery whitish: head and thorax grey; antennæ with brown pectinations; abdomen testaceous. Under surface pale whity brown: wings with the costal borders testaceous; each wing with a dentate-sinuate grey discal line and a blackish marginal line. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

The single female example obtained is darker than the male, the primaries being varied with bronzy brownish, and the area enclosed by the blackish lines distinctly grey; this example, however, is small and has the primaries so much narrower than other examples of this genus that I suspect it to be aborted.

Hyberniidæ.

HYBERNIA, Latreille.

204. *Hybernia dira*, n. sp.

General character of *H. leucophæaria*: primaries fuliginous brown, streaked here and there with tawny; a central irregular black-edged and speckled pale greyish belt, concave internally, unequally bisinuated externally; base greyish; outer border pale, bordered internally by an irregularly sinuated white line; a series of black marginal spots; fringe white, grey-speckled at base: secondaries pale greyish, speckled with grey, streaked with blackish on the abdominal area at anal angle; a black marginal line: body grey, black-spotted. Under surface greyish: wings with bronze-tinted borders and

blackish discocellular dots : secondaries speckled with grey.
Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

Most nearly allied to *H. obliquaria* of Motschoulsky.

Larentiidæ.

LARENTIA, Duponchel.

205. *Larentia Hemana*, n. sp.

Closely allied to *L. salicata*, but the central band of primaries of nearly twice the width, the wings altogether paler, and the secondaries similar in marking to *L. cæsiata*. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Unless carefully compared with *L. salicata* of Europe, this species might easily be confounded with it.

EUPITHECIA, Curtis.

206. *Eupithecia sophia*, n. sp.

Allied to *E. denticulata* of Europe ; sordid white with pale greyish outer borders and fringes to the wings, and black discocellular spots : primaries with the basal half of costa and the basal area blackish, crossed by irregular white lines ; remainder of the wing crossed alternately by grey belts and white lines, the widest of which form an indistinct central oblique band ; all the lines zigzag : secondaries crossed by one or two indistinct greyish lines. Wings below whiter, shining, the markings of the primaries only visible through the wings, excepting upon the costal border. Expanse 9 lines.

Yokohama (*Jonas*).

207. *Eupithecia invisæ*, n. sp.

Pale silky greyish ; external area of wings crossed by five slightly irregular parallel grey lines, most distinct on the primaries, the two inner lines dotted with black upon the nervures ; discocellular spots black : primaries with the costa dusky, crossed by dark spots ; a very ill-defined oblique belt across the centre of the wing, but scarcely darker than the ground-colour. Under surface whitish ; the discal lines indicated by a series of dusky spots, two at costa of primaries blackish ; discocellular spots black. Expanse 1 inch.

Hakodaté (*Whitely*).

This species is allied to the preceding ; owing to its greyer tint it is much less like *E. denticulata*.

208. *Eupithecia excisa*, n. sp.

Nearly allied to *E. succenturiata* of Europe, but differing in its smaller size, greyer primaries, and in the front margin of the central belt of primaries being deeply and angularly notched beyond the discoidal cell. Expanse 11 lines.

Yokohama (*Jonas*).

209. *Eupithecia rufescens*, n. sp.

Apparently allied to *E. satyrata* of Europe, but much larger and with considerably longer palpi; an oblique subbasal belt and the external area of the primaries laky brown; a black marginal line enclosed in and interrupted upon the veins by a white line. Expanse 11 lines.

Yokohama (*Jonas*).

210. *Eupithecia proterva*, n. sp.

Allied to *E. innotata*, larger; the primaries still more produced, pale smoky grey: primaries with the base, a subbasal band, an oblique whitish-edged central belt (angular, excised above the median vein), and the external area blackish; a crinkled whitish submarginal line; discocellulars black: secondaries covered with parallel dusky lines, which become black upon the veins. Wings below grey; the discocellulars, two discal series of dots, and a marginal series black. Expanse 1 inch.

Yokohama (*Jonas*).

211. *Eupithecia caliginea*, n. sp.

Near to *E. pygmæata*, but the ground-colour of the wings black instead of sooty grey; the crinkled lines across the primaries formed of white scales. Expanse 10 lines.

Yokohama (*Jonas*).

This is the Japanese representative of *E. pygmæata*.

COLLIX, Guénée.

212. *Collix Vashti*, n. sp.

Dark fuliginous brown; the wings crossed by from eighteen to twenty parallel undulated blackish or black lines, more or less dotted with white upon the nervures; submarginal line indistinctly white-edged on the primaries; marginal line well-defined and black, the sinuations filled by white dots on the fringe: secondaries with all the lines less distinct than

on the primaries. Under surface sericeous, the blackish lines ill-defined. Expanse 1 inch 2-8 lines.

Hakodaté (*Whitely*).

LOBOPHORA, Curtis.

213. *Lobophora julia*, n. sp.

Primaries above pale purplish brown, crossed by numerous irregularly crinkled or zigzag blackish lines; two pale green belts across the basal area, and a zigzag discal belt of the same colour, edged internally with white; a slender zigzag submarginal white line; a large black discocellular spot: secondaries pale shining grey, the disk crossed by several parallel slightly darker lines. Abdomen banded with testaceous. Wings below pale silvery grey, with black discocellular dots; a blackish macular discal line, and a zigzag pale grey submarginal line. Expanse 1 inch.

Yokohama (*Jonas*).

This species, excepting in its long palpi, somewhat resembles *Eupithecia togata*.

214. *Lobophora volitans*, n. sp.

♂ ♀. Wings white: primaries shining, more or less densely sprinkled with grey scales, and crossed by a basal and two central black-edged sap-green bands; a discal sinuated black-edged white stripe, more or less obscured by grey scales; outer border greenish, with a marginal series of black -shaped markings terminating the veins; the veins throughout black-banded: secondaries with a discal line and a sinuated submarginal line pale grey; a dark grey marginal line. Body grey, varied with brown, and spotted here and there with black; legs black, banded with white. Under surface sordid sericeous whitish: wings crossed by two greyish discal lines; blackish linear discocellular and marginal dots. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Var. *elegans*.

♂. Primaries with the basal and central bands reddish brown instead of green; the outermost or discal band being more distinctly lunulated and white internally. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

215. *Lobophora terranea*, n. sp.

Similar in form to the preceding, but the wings smaller

and rather narrower, grey: the primaries crossed by three basal, two more or less confluent central belts, and one discal sinuated belt; basal and apical areas suffused with red-brown; central belts red-brown with blackish outlines; other belts outlined in blackish; veins banded with blackish; a series of marginal dots: secondaries with whitish costal area; a sub-marginal pale grey line. Under surface sericeous grey. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Allied to *L. polycommata*.

LYGRANOA, n. gen.

Allied to *Lobophora*, but the primaries broader and more acuminate, the discoidal cell considerably shorter, the second and third median branches emitted much closer together, the upper radial emitted from the end of the cell instead of from the postdiscoidal cellule; antennæ strongly pectinate in the male. Type *L. fusca*.

216. *Lygranoa fusca*, n. sp.

Pale brown, wings with slender blackish marginal line, followed by a yellowish line at the base of the fringe: primaries with dusky base; an abbreviated black costal dash across the end of the cell, and a second halfway between the cell and apex; two irregular subparallel brown lines running from the costal dashes across the wing to inner margin; a subapical black costal spot; fringe whitish, intersected by a grey stripe. Wings below sericeous whity brown; discocellular dots and a discal series grey: primaries with bronzy borders; fringe as above, but more decidedly grey-spotted at the ends of the veins. Expanse 11 lines to 1 inch 2 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

MELANTHIA, Duponchel.

217. *Melanthia casta*, n. sp.

Nearly allied to *M. albicillata*, but larger; the markings more sharply defined and blackish; the macular subapical portion of the interrupted discal stripe bifid, not trifid, and therefore not united to the large costal patch; discocellular spots black and well defined. Wings below with darker markings; the macular discal stripe well defined in the secondaries as well as the primaries. Expanse 1 inch 6 lines.

Hakodaté (*Whitely*).

MELANIPPE, Duponchel.

218. *Melanippe inquinata*, n. sp.

Closely allied to *M. procellata* of Europe, but larger; the wings always more or less suffused with grey, sometimes only enough to make them look sordid, sometimes so dark as almost to conceal the ordinary markings: primaries with the basal dark patch broader, and the dark outer border of twice the width. Expanse 1 inch 7 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

219. *Melanippe bella*, n. sp.

Allied to the preceding, but with unusually small secondaries: wings white, suffused, excepting at the borders, with stramineous; the apical and external or anal borders blotched with red-brown and bounded internally by a discal series of blackish rounded spots, interrupted on each wing upon the second median interspace; black discocellular spots: primaries with the costal border spotted with red-brown and grey, most broadly above the end of the cell; a tawny spot near the base of inner margin; two or three very indistinct slender brownish lines across the wing, the outermost one zigzag: secondaries with a grey basal stripe, a central grey肘ed belt, and an arched grey stripe just beyond the middle: body white, head sordid, antennæ black. Wings below with all the markings black or grey; a central belt followed by a grey streak on all the wings; basal area of primaries greyish: body grey, whitish in front; legs varied above with black and white. Expanse 1 inch 4-6 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

220. *Melanippe supergressa*, n. sp.

Closely allied to *M. rivata* of Europe, the markings blacker, the discal white belt beyond the central band broader; the base of secondaries white, irrorated with grey, but not densely; three central parallel dark grey lines not reaching the costa: wings below with the markings better defined. Expanse 1 inch 1 line.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

The whiter base to the secondaries and blacker bands are the best characters for distinguishing this species from its European congener.

221. *Melanippe hecate*, n. sp.

Black, mottled indistinctly with grey: wings with the fringes spotted with white; a broad irregular white band just

beyond the middle, strongly angulated on the primaries; these wings also with a double submarginal series of pale spots; the inner series with one upon the costa, and a second just beyond the angle of the irregular band, white: back of head white, antennæ dotted with white, abdomen with white margins to the segments. Wings below greyer than above, the basal area crossed by parallel transverse whitish streaks; body white. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

Allied to *M. furcifascia*, but the white band broader, more strongly angulated on the primaries, and continued through the secondaries.

ANTICLEA, Stephens.

222. *Anticlea consanguinea*, n. sp.

Nearly allied to *A. berberata* of Europe, but of a more uniformly grey colour: primaries with the bands broader, the subbasal band more regular, the dark band just before the middle of the wing distinctly angulated above the median vein; the discal band less strongly dentated; outer border broadly dusky, completely obliterating the sinuated submarginal lines: secondaries greyish brown, crossed beyond the middle by an angulated and sinuated dusky line. Wings below similar in colouring to those of *A. berberata*, but with a strongly defined continuous discal line. Expanse 1 inch 2 lines.

Hakodaté (*Whitely*).

COREMIA, Guénée.

223. *Coremia livida*, n. sp.

Allied to *C. ferrugata*, but uniformly greyish brown; the basal bands more decidedly undulated, and only indicated in outline by dark lines; the broad dark belt further from the base, its margins more decidedly undulated, its inner margin more irregular, its outer margin less decidedly angulated; outer border smoky grey, bounded by a continuous series of white-edged dark lunules, those spots which are dark in *C. ferrugata* being only slightly darker than the others; the zigzag discal line of the European species replaced by a sinuated line forming an internal boundary to the submarginal lunules; lines across the secondaries less strongly defined: wings below more uniform in tint and sericeous grey, with the sinuated parallel lines arched rather than angulated. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

224. *Coremia frigida*, n. sp.

White, the primaries spotted at the base with black and smoky brown; two central angulated black lines, indicating the usual band, the outer one diffused internally above the middle; a black spot at the end of the cell; outer border smoky brown, margined and traversed internally by two black lines parallel to the outer of the two central lines; veins upon the border black, each with a central white dot, the whole together forming a submarginal series; fringe white-spotted: secondaries silver-grey, with the external area regularly white; a marginal series of dark grey spots which run through the fringe; a blackish discocellular spot: body whitish, greyish in front, dotted with black; antennæ black annulated with white. Primaries below with the basal two thirds silver-grey, crossed near the base by two grey stripes visible only from the transparence of the wing, the inner one marked with two blackish spots; an oblique black fasciole across the end of the cell, partly limiting the grey area; an angulated white discal belt, followed by a black border; a white subapical costal dot, and a series on the fringe: secondaries as above: body below white. Expanse 1 inch.

Yokohama (*Jonas*).

A beautiful little species, in pattern most nearly resembling "*Coremia*" *heliacaria*; the latter, however, has strongly pectinate antennæ in the male.

CIDARIA, Treitschke.

225. *Cidaria melancholica*, n. sp.

Allied to *C. silaceata*, but considerably larger, the white line nearest to the base of primaries more regular, not succeeded by a yellow line; the line which follows it (indicating the inner edge of the central band) acutely angulated upon the median vein; the lines and veins on the external area, which are yellow in *C. silaceata*, pale testaceous or sordid whitish; a small blue-pupilled ocellus beyond the discoidal cell; secondaries smoky grey throughout, with the usual sinuated white-edged discal lines. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

Typical *C. silaceata* seems to be common in Japan.

226. *Cidaria obscura*, n. sp.

Most like very dark varieties of *C. russata*, but altogether darker and with a different pattern on the underside. Greyish brown, the primaries with a pink tinge, markings extremely

like those of *C. russata*, dark brown, limited by pale-bordered black lines; a slightly sinuated black outer margin and grey-tipped fringe: secondaries with dusky external border, on which there is an indication of a paler submarginal sinuated line; a black scalloped marginal line; fringe grey, with pale basal line. Wings below grey, with pale testaceous costal borders; dusky discocellular dots; three parallel darker grey postmedian lines, followed by a whity-brown broadly sinuated discal belt; a submarginal dusky belt followed by an ill-defined undulated pale line; outer border grey; fringe whity brown: body whity brown. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

C. russata is common in Japan.

227. *Cidaria aërosa*, n. sp.

Closely allied to *C. reticulata*, but nearly twice as large and with all the lines of primaries brassy yellow instead of white; secondaries and body tinted with brassy yellow; under surface pale brassy yellow, with indistinct greyish markings similar to those of *C. reticulata*. Expanse 1 inch 9 lines.

Hakodaté (*Whitely*).

228. *Cidaria tetrica*, n. sp.

Nearest to *C. suffumata*, but considerably larger; the primaries mottled all over with olivaceous, with diffused bronzy borders to the veins; the markings may be thus described:—Wings dark brown, crossed by three silvery bands, all of which are forked, the first two from the median vein, the third from the upper radial or inferior subcostal branch; central band twice as wide as the others; between each two bands and between the external band and outer margin a slender silvery more or less sinuated line; a marginal series of silvery spots with black centres: secondaries white, speckled with grey; two parallel discal grey lines, on the outer one several blackish spots; a marginal series of blackish spots; fringe yellowish: body brown, banded with pale yellow and white. Under surface shining white: primaries mottled with grey; costa speckled with black: secondaries speckled with brown and grey; a brown discocellular spot and a brown angulated discal line; a grey interrupted submarginal line. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

229. *Cidaria cineraria*, n. sp.

Very closely allied to *C. picata*, but the markings blacker;

the central band of primaries not notched at the second median branch: all the yellow or yellowish olivaceous markings replaced by ashy grey: the white belt of secondaries wider, the body darker. Expanse 1 inch 4 lines.

Hakodaté (*Whitely*).

230. *Cidaria jameza*, n. sp.

Allied to *C. inspurcata*: primaries sepia-brown, crossed near the base by two irregular white lines, undulated and angulated above the median vein: two black-edged very irregular dentate-sinuate white discal lines, only separated by a brown centre line; a dentate-sinuate white submarginal line; centre of external area sprinkled with white scales: a black-spotted white marginal line; fringe spotted with whitish: secondaries grey; costal area, an angulated chain-like postmedian belt, a dentate-sinuate submarginal line and the margin white: a marginal series of black spots; fringe as in primaries: thorax brown, abdomen grey. Wings below with the basal area uniformly grey, limited externally by the discal line, which is represented by subconfluent black spots; discocellulars black. Expanse 1 inch 3 lines.

Hakodaté (*Whitely*).

Euboliidæ.

EUBOLIA, Duponchel.

231. *Eubolia nipponica*, n. sp.

Primaries with the basal two thirds smoky brown, blackish externally, and limited by an irregular bracket-shaped whitish line; external third paler white towards the border; two irregular arched whitish-edged black lines near the base; a black spot at the end of the cell; three or four subapical white dots; two black subapical spots: secondaries pale smoky brown, with a central whitish-edged dusky bracket-shaped line; outer margin white, dotted with black: thorax blackish, abdomen brown: under surface paler, the basal lines obsolete, the veins on the disk with reddish borders; black discocellular spots well-defined. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

Allied to *E. manriaria*.

LI.—Notes on the Internal and External Structure of Palæozoic Crinoids. By CHARLES WACHSMUTH*.

[Continued from p. 392.]

5. The Construction of the Summit, and its Value in Classification.

The construction of the ventral disk or actinal side of the calyx has heretofore received less attention than almost any other part of the Crinoids; and thereby an important aid to classification has been overlooked. I think it affords a clear and most important distinction between recent and ancient Crinoids, and shows that they fall naturally into two great divisions or groups. This view, although it does not agree with the opinion of other authors, who, in their classifications, have placed a number of Palæozoic genera in the same group with the recent Crinoids, is, as I hope to show, well founded.

Dr. F. Roemer, in the 'Lethæa Geognostica,' 1855, p. 227, divides "*the true Crinoids*, which are supported by an articulated or jointed column," into two divisions:—

a. Crinoids in which *the ventral side consists of a soft skin*.

b. Those in which *the ventral side is covered by solid immovable plates*.

Roemer includes with the former group Pentacrinidæ, Apio-crinidæ, Eugeniocrinidæ, Encrinidæ, Cupressocrinidæ, and Cyathocrinidæ. This division seems to have been based on mere conjecture, since a membranous ventral surface has been observed only in the Pentacrinidæ and the recent Crinoids generally, though it is probable that *Eugeniocrinus* and several allied genera had that summit structure. In the Apio-crinidæ and Encrinidæ, however, the general construction of the dorsal or abactinal parts, the massive plates, both of calyx and arms, indicate rather a closer relationship with the ancient Crinoids, and suggest the existence of a solid dome. The latter becomes more probable since a solid vault has been discovered in *Belemnocrinus*. This genus is in its generic formula and general form almost identical with the recent *Rhizocrinus*, which, on the contrary, is covered by a soft peristome. Both are closely related to *Apiocrinus*; *Belemnocrinus* particularly has the same heavy body-plates and the small visceral cavity; and it appears to me that *Apiocrinus* is more nearly allied to the Palæozoic type than to the recent *Rhizocrinus*.

The Cupressocrinidæ and Cyathocrinidæ are the only groups from Palæozoic formations which Roemer places in his divi-

* From 'Silliman's American Journal,' Sept. 1877.

sion *a*. Dr. Schultze, who adopted Roemer's classification, included in the Cupressocrinidæ the genera "*Synbathocrinus*, Phill., and *Phimocrinus*, L. Schl.," in which he is undoubtedly correct, for stronger reasons even than he himself perceived. These two genera agree with *Cupressocrinus* not only in the simplicity of their arms, but also in the so-called "consolidating apparatus," which he describes and figures in the latter. The apparatus is placed horizontally in *Cupressocrinus*, upright and turbinate in the two other genera. When the consolidating plates in *Synbathocrinus* are preserved, the ventral side appears to have two separate apertures, a lateral proboscis and a central mouth. And so the genus was originally described. This, however, is a misconception. By removing carefully all the arm-joints from a specimen of *Synbathocrinus*, I discovered the central aperture perfectly covered with a number of small plates; and to this summit, as it might be called, were attached narrow lateral extensions, composed of alternating pieces, which, passing downward, covered the little grooves that lead to the arm-furrows. The consolidating apparatus here forms, in fact, a part of the solid vault. It is reasonable to conclude that in the allied genera *Cupressocrinus* and *Phimocrinus*, so closely related to *Synbathocrinus* otherwise, the central opening was closed, and that the consolidating plates were further overlaid with plates forming the floor of a passage in connexion with the arm-furrows and visceral cavity. The small plates which extend out to the arms are in the specimen but partly preserved, and the connexion with the arm-furrow is interrupted; but there can be no doubt that the channel underneath contained the food-groove and ambulacral canal which I have described in *Cyathocrinus*. The covering of the central opening of *Synbathocrinus* resembles in a remarkable degree that of the central aperture of the Blastoids; and it seems to me highly probable that the consolidating plates are homologous with the partly hidden deltoid pieces of the latter.

Among the Cyathocrinidæ Roemer included genera of widely different types. Besides the typical one, he enumerates nine genera, only two of which, *Heterocrinus* and *Graphiocrinus*, have the characteristics of the Cyathocrinidæ; and both of them evidently possess a solid dome, as is proved by their heavy proboscis. All the remaining genera belong to other groups. *Macrostylocrinus* resembles *Ctenocrinus*, Bronn, and *Cytocrinus*, Roemer, so closely, that they may yet prove to be identical. Roemer, however, places *Ctenocrinus* with *Glyptocrinus* among the Crinoids with a solid dome, and *Macrostylocrinus* among the Cyathocrinidæ. *Macrostylocri-*

nus is allied to *Melocrinus*, and has undoubtedly a similar summit-structure. The same may be said of *Schizocrinus* and *Dimerocrinus*, which are not at all related to *Cyathocrinus*.

The genus *Cyathocrinus* was originally described by Prof. Phillips and Mr. Austin as having a separate mouth and vent, which was considered by these authors and others to be its chief distinction from *Poteriocrinus*. Accordingly, all species with a proboscis or solid dome, though otherwise agreeing with *Cyathocrinus*, were referred to *Poteriocrinus* or some allied genus. Meek and Worthen, however, proved (in the Geological Report of Illinois, vol. v. p. 325) that in perfect specimens the central opening is closed. The covering of *Cyathocrinus* is exceedingly interesting, and throws light upon the summit-structure of many genera. I shall herein refer frequently to Meek and Worthen's excellent figures, vol. v. pl. ix. figs. 13, 14.

Looking only at fig. 14, one would at first naturally suppose there must have been, during the life of the animal, two distinct openings in the vault. But on examining it more critically, and comparing it with fig. 13, it will be found that fig. 14 represents simply the consolidating apparatus as figured by Roemer and Schultze in *Cupressocrinus*, placed here exactly as in that genus, and consisting of five large pieces, alternating with the upper edges of the first radial plates. The plate of the anal side is larger than the others, and forms the base of the inner side of the proboscis. The five pieces, which connect with each other laterally, extend inward for some distance, but not so far as to meet in the centre, where there is a semicircular or heart-shaped opening. Along the sutures between the five plates a comparatively large furrow from each arm-base extends inward, and leads to the central opening. Examining now fig. 13 we find the general aspect of the ventral disk entirely changed. The lateral opening has been transformed into the base of a proboscis; and the consolidating plates are partly covered, leaving but a small uncovered space, in the form of a delta, in the interradian areas. The central opening is vaulted over by a number of various-sized pieces, the largest one occupying the side towards the proboscis. The shallow groove between the sutures of the consolidating plates is arched by a double series of alternating plates, forming underneath a passage for the ambulacral canal and food-groove. The vault, thus closely resembling that of *Synbathocrinus*, was in all probability arranged on a similar principle in *Cupressocrinus*. The same plan, with slight modifications, prevailed in *Poteriocrinus*,

Scaphiocrinus, and all genera with an *inflated* or *balloon-shaped ventral sac*. Among the latter the centre of radiation is frequently found to be pushed toward the anterior side, so that, owing to the great size of the sac at its junction with the dorsal cup, it does not occupy the centre of figure.

Among all groups of Crinoids, the Cyathocrinidæ undergo the least amount of change in the course of time. They are represented in the Lower Silurian by several genera; and *Cyathocrinus* is the only genus recognized in the Permian. In all intermediate formations we find Crinoids with five basals, five subradials, and five radials; and it is worthy of note that the Cyathocrinidæ, in the structure of their vault, bear closer resemblance to the recent Crinoids than almost any other group, and seem to hold an intermediate position between modern and Palæozoic types. If the alternating plates covering the furrows could be turned back at the vault by the animal as the Saumplatten of the arms, then the food-groove of these Crinoids was open throughout, as in recent forms. This might possibly have been the case in *Cyathocrinus iowensis*; but I even doubt it here, as the corresponding plates in other closely related species, though arranged upon the same fundamental plan, present rather an aspect of true vault pieces. The Cypressocrinidæ and Cyathocrinidæ thus fall naturally into a group by themselves, having the vault supported by consolidating plates, and covered by an immovable arch of small plates.

The next group, including *Taxocrinus*, *Forbesiocrinus*, *Onychocrinus*, *Ichthyocrinus*, *Lecanocrinus*, and probably other genera, is one in which, of all Palæozoic Crinoids, the vault is least known. The Taxocrinidæ (for such I will call them) have hitherto been described as being covered with some soft material instead of solid plates, even by Dr. Schultze, though he describes and figures a *Taxocrinus* with a long, heavy, plated proboscis, which could not have been supported upon a soft skin*. In this group the plates of the radial series are indented on their upper margins more or less deeply for the reception of a protuberance from the lower side of the succeeding plate. The indentation of the upper margin does not extend throughout the thickness of the plate; and in *Forbesiocrinus* it is filled by a superficial patelloid plate, which is

* I believe Dr. Schultze is mistaken in referring his *T. briareus* to *Taxocrinus*, as it lacks all the characteristic features of the genus. Its rather large subradials, the large first radials as compared with the succeeding radials, the single anal plate upon which the heavy proboscis rests, indicate that it belongs to *Cyathocrinus* or some allied genus. His *T. gracilis* may prove to be *Graphiocrinus* or *Scaphiocrinus*(?).

separately articulated and sometimes ankylosed with the outer margin of the plate above. This peculiarity not only exists in the arm-plates, but is conspicuous in the radials, thus producing apparently an articulate structure of the whole skeleton and indicating some degree of flexibility in the body as well as the arms. The interradial portions appear sometimes depressed, and in other cases swollen or bulged out, showing that they probably yielded to a moderate expansion or contraction of the body-walls, due to the mobility of the radial parts, which likewise involves a flexibility of the summit. I have not been so fortunate to find the summit of any of these genera perfectly preserved; but I feel convinced from what I have observed that it did not consist of a soft skin. In *Onychocrinus*, the genus which possessed evidently the greatest expansive power, the radial plates are frequently found spread out horizontally, and I have found towards the inner or ventral side of the radials rather large imbricating plates, to which smaller ones are attached which connect with the plates of the interradial series, and which decrease in thickness inwardly. In several specimens I found the inner part or centre of the disk covered by a number of thin, very small plates, whose arrangement could not be made out; but it is highly probable, from their size and shape, that they formed a kind of scaly integument which was pliant and flexible, thus facilitating a contraction or expansion of the dorsal portions.

The close relationship existing between *Onychocrinus*, *Forbesiocrinus*, and *Taxocrinus* renders it almost certain that their summit was similarly constructed. In *Ichthyocrinus* the peculiarities in the radial portions are less strongly marked, and the genus has no interradial plate; but as it agrees otherwise so nearly with *Taxocrinus* that it is sometimes difficult to separate them, we may feel sure that this Silurian genus forms no exception to the general rule, but that its mouth was covered as in other Palæozoic Crinoids.

That the summit in several genera has not been discovered is no proof that it consisted of soft material. During the eighteen years that I collected at Burlington I obtained several hundred of the most perfect specimens of *Cyathocrinus*, some of them as perfect in most of their parts as if dredged from the ocean; but only two specimens have been discovered in which the summit was preserved, and only a single *Scaphiocrinus*. That this could happen at a locality where even the finest tissues of the most delicate internal organs are preserved, is somewhat astonishing; but yet it can be accounted for by the fact that the pieces which cover the central opening, as also the small alternating plates forming the ambulacral canal,

are very thin, and that they rest but partly upon the consolidating plates, being thereby rendered insecure and liable to removal by any accident, even with very small force. Moreover the arms of the Cyathocrinidæ are generally attached, and the ventral disk thus hidden from view. In specimens in which the arms are destroyed their destruction almost invariably involved that of the entire ventral side; and so delicate are these parts, that even when the arms are well preserved and so situated as to expose the dome, the plates are nearly always gone, or are found in a confused mass inside the calyx.

I come now to another group, in which, on the basis of the summit-structure, such apparently diverse forms are included that I am under the necessity, very unwillingly, of making a name for it. It includes the families Actinocrinidæ, Platycrinidæ, Rhodocrinidæ, Melocrinidæ, and the genera *Schizocrinus*, *Dimerocrinus*, and *Macrostylocrinus*, which Roemer has ranged among the Cyathocrinidæ; and I call it provisionally the Sphæroidæ, from the form of the calyx, which is generally somewhat spherical. This large group, embracing over one hundred genera, and ranging from the base of the Silurian to the top of the Subcarboniferous, is capable of accurate definition, is easily distinguished, and, fortunately, the summit is very commonly found well preserved in most of the genera.

The summit is composed of heavy, frequently nodose plates, closely cemented together so as to form a *free arch* (not supported by consolidating plates), which rests like a hemisphere upon the dorsal cup. The plates of the summit, which at first sight exhibit great apparent diversity, are arranged throughout upon one and the same fundamental plan. Beginning with genera that have but few vault-pieces, we find in them the median portion occupied by one large centre plate, surrounded by six others—four large ones of equal size, and two smaller ones. The four large plates join laterally, and are often placed directly to the centre piece. In very large species and sometimes in very old specimens the plates are separated by small polygonal pieces, but easily recognized by their size. Two of the four plates lie above the interrarial series adjoining the anterior ray; the two others, one at each side, are placed between the two lateral rays. The two smaller plates are separated from each other by anal plates or by the proboscis. These seven pieces, which I will call the "*apical plates*," are easily recognized by their greater prominence and size in species with comparatively few summit-plates and a lateral anal aperture; but their identification is more difficult in

species in which a subcentral proboscis is placed between the two small plates, and the whole vault looks like an immense proboscis. In these forms the four large plates, together with the two smaller ones, are pushed towards the anterior side of the specimen, while the centre plate rests with one side against the proboscis.

There are other summit-plates following a radial direction, which are either attached to the apical pieces or separated from them by a belt of small polygonal plates. Their number, which varies greatly in different species, depends upon the number of primary arms that spring out directly from the body, no matter how often the arms branch afterward. In species with only two arms to the ray, each ray has two rows of corresponding plates in the dome: one large bifurcating plate forms the upper row, three plates the second row; two of the latter are brachial plates, the third one is an interbrachial plate separating the two arms. In rays with three arms, there are eight plates in three series. The upper series consists of one large bifurcating plate, which evidently corresponds with the third radial of the dorsal side. The second series, corresponding to the secondary radials, is composed of two plates, the plate towards the division with two arms being as large as the plate of the upper series, and the one towards the single arm much smaller. The third series is formed by three brachial and two interbrachial plates. In species with four arms to the ray, both radial pieces of the second series are large, and from each of them there originate two brachial pieces. As a general rule the summit-plates increase in proportion to the number of primary arms of a species in the same manner and on the same principle as the plates of the dorsal side. Every radial from the third radial upward has a corresponding plate on the ventral side, and additional interbrachial plates between corresponding brachial plates above the arms. Therefore in adult specimens, with some little practice, the number of arms can be ascertained nearly as well from the dome as from the dorsal side. The number of vault-pieces is enormous in some genera, especially if the radials branch off alternately, as, for instance, in *Strotocrinus*, where some species have 120 to 180 arms. In looking at a full-grown specimen, with its many hundred apparently irregularly arranged vault-pieces, one would scarcely expect to be able to discover that this construction, in nearly all the Palæozoic Crinoids, is based upon a definite plan, and that plan the same as prevails below the arms. That this is the case may be successfully demonstrated in the young *Strotocrinus*, which has comparatively fewer summit-plates.

The young specimen, in genera with numerous arms, has fewer arm-openings than the adult, though both have the same number of arms. This is best observed in the young *Strotocrinus*. Here the basals, primary radials, first anal, and first interrarial pieces are comparatively large, while the higher series of interradians are yet absent or but slightly developed. The radials of the higher orders, which in adult specimens form a part of the body, are in young specimens free arm plates, unsupported by any interrarial or interaxillary pieces. The arms, therefore, which spring directly from the body in adult specimens, in the young branch alternately right and left after emerging from the body, the spaces between the bases of the branches being subsequently filled by the upward growth of the body, so that the branching, instead of occurring in the free arms, seems to be completed in the body-walls. So, for instance, the young *Strotocrinus umbrosus* has at first but four arm-openings to the ray; at a later period it is found to have eight, and in the adult state twelve, being a separate opening for each arm*.

The rule that the number of summit-plates increases in proportion to the number of primary arms holds good with reference to the young specimen. The young *Strotocrinus* has fewer plates than the adult individual (the difference being in proportion to the state of growth); and these are arranged in the same order, and are as easily recognized, as those of the simplest species of this group. The apical and principal radial pieces are larger than the intervening interrarial plates, which, exceptionally in this genus, attain by age the same size as the apical and radial pieces. The interrarial plates of the vault occupy the intermediate spaces between the radial areas. As their number depends greatly upon the age of the individual, they vary often in the same species. In species with but few arms, we find comparatively few interradians, and those are generally smaller than the other plates. The latter is especially true in young specimens, as also in small species. Sometimes (as, for instance, in some *Megistocrini* and all *Rhodocrinidæ*) the greater part of the summit is covered by large numbers of small polygonal plates which form regular belts

* A young *Strotocrinus*, unless the arms are attached, cannot be distinguished generically from an adult *Actinocrinus proboscidialis*; and as both have the same peculiar ornamentation with the same number of arm-openings, they differ but slightly in specific characters. *Actinocrinus proboscidialis* is the typical species of a small group of beautifully ornamented Crinoids, and it is evidently the forefather of all *Strotocrini*, which idea seems to be further confirmed by the geological succession. The former group occurs only in the Lower, and *Strotocrinus* only in the Upper Burlington Limestone.

around the apical and radial plates. The species of these genera, though comparatively of large size, have generally but two primary arms, and consequently for each ray but one radial dome-plate, which is here placed at some distance from the arm-bases. In the *adult Megistocrinus* the radial as well as apical plates are extremely large, and stand forth conspicuously, and each one separately, among the surrounding minute polygonal pieces. In the *young Megistocrinus*, however, and in the Rhodocrinidæ generally, the apical pieces and the radial plate are placed side by side, being surrounded by the polygonal plates. The form and size of the principal summit-plates, the distribution and number of the interradian pieces, afford most excellent characters for distinguishing many genera. In *Agaricocrinus* all apical and radial pieces are large and tuberculous, the few interradians are small. In *Dorycrinus* the centre plate and first radials are spiniferous or nodose. In *Amphorocrinus* the four large apical pieces are spiniferous or tuberculous, the radials nodose. In *Platycrinus* and *Hexacrinus* the apical plates are very prominent, often tuberculous, the radial portions are somewhat constructed like the rows of small alternating plates of the Cyathocrinidæ. In *Batocrinus* all summit-plates are nodose and almost of equal size.

The apical plates can be distinguished in other groups as well as in this. They surmount the vault of *Synbathocrinus* and *Cyathocrinus*, cover the central opening of the Blastoids, and can be traced in many of the Cystideans. This, with the further fact that they are so largely developed in young specimens, that they cover and protect some of the most important organs of the inner cavity, shows their great importance, and leads us to infer that they were the first solid parts developed on the ventral side in young Crinoids. The centre piece corresponds evidently with the basals of the dorsal side, the surrounding plates to the subradials (the two smaller plates separated by the anus forming together one large one), which, on the other hand, were undoubtedly the first-developed parts of the dorsal side, and the parts which are the most highly developed in the Cystideans.

The above groups, representing the three principal plans upon which the vault is constructed, embrace, according to my views, not only all those Palæozoic genera which were supposed to be covered by a membranous surface, but nearly all Palæozoic Crinoids that are known. There are some few genera, as, for instance, *Eucalyptocrinus*, with a very peculiar superstructure at the ventral side, whose affinities I have not been able to determine. There is the genus *Calceocrinus*,

which differs so widely from all other known Crinoids by its distinct bilateral symmetry and unique structure that it forms evidently a very distinct group by itself. There may be still others, differing in their summit-structure from the general plan; but I have yet to discover a single Palæozoic genus in which a special oral aperture has been identified, or in which the existence of a solid vault has been disproved or cannot be traced by analogy. Thus it may be possible that the solid vault was essential under the conditions which prevailed in the earlier geological ages.

Closely related as the recent Crinoids are to their Palæozoic ancestors in some points, the solid vault of the latter cannot in the remotest degree be homologized with the soft peristome of the former. The solid dome forms, as I think I have proved, a continuation of the radial and interrarial series of the dorsal side, and serves merely as a covering and protection for the organs underneath. It is in every sense of the word aboral, and forms a part of the abactinal system, which, being already reduced in the Pentacrinidæ and Comatulidæ to a narrow tentacle-furrow, recedes in the Palæozoic Crinoids one step further, and disappears within the solid walls of the body. The actinal system here consists externally only of the arm-furrows, whence it continues underneath the vault. These Crinoids, therefore, are evidently of lower development and belong to an inferior type.

The ventral peristome of the recent Crinoids serves as a madreporic apparatus, introducing the necessary water for respiration. It is capable of expansion, and does expand when water or food is introduced into the inner cavity, and contracts when refuse matter is expelled. These are functions which the solid vault could not have performed; and there must have been, consequently, important modifications in the internal economy of these animals. Comparing the large size of the calyx of the *earlier* Crinoids with the small cup and large long arms of the *recent* types, we find in the former an approach to the *Cystideans*, as also a striking resemblance to the nascent *Pentacrinus* before its arms are fully developed. In the older forms, the radial plan is almost overshadowed by the bilateral arrangement of the vault, which reminds of the bilateral symmetry in the earlier stages of other Echinoderms. All these facts tend to prove that the *Palæozoic Crinoids*, embracing therein all *true Crinoids in which the actinal side is closed*, represent the young stage of growth of the living types. They bear evidently the same relation to the Pentacrinidæ and Comatulidæ as the Perischoechinidæ bear to the Echini, as the *Cystideæ* and *Blastoideæ* bear to the *Palæozoic*

Crinoids. They unquestionably form a *distinct group* of Crinoids; and I therefore propose for it, from the fact that its representatives lived almost exclusively in Palæozoic times, the name "*Palæocrinoidea*," as a suborder of the *Crinoids*.

Whether *Encrinus*, *Apiocrinus*, and allied genera of the Jurassic time are to be brought within this suborder, depends upon the construction of their vault, which cannot at present be determined. Should they prove to have a solid dome, they would be included here; and this might detract slightly from the technical exactness of the name *Palæocrinoidea*. Still, as its characteristic types were so prevalent, and constituted so important a part of the life of Palæozoic ages, and the Mesozoic forms are comparatively so insignificant in variety and abundance, the term would nevertheless be significant and appropriate.

I shall not attempt to separate the *Palæocrinoidea* into families, as I think our present knowledge is hardly sufficient for such a work; but I feel convinced that it must be based mainly upon the diversities in the structure of the vault, not upon the construction of the dorsal cup, nor upon the structure of the arms or column, upon which former authors have founded such divisions.

The discoveries which have been made within the last few years, both in recent and extinct Crinoids, are really wonderful, and lead us to expect large additions to our knowledge in the future. I observe, in the February number of the 'American Journal,' that Prof. Thomson has discovered at great depth two new genera of *Apiocrinidæ*, one of them resembling in superficial structure the genus *Poteriocrinus*. This may throw new light upon the physiology of the extinct types and solve some of the questions herein suggested. Other discoveries will follow. The labours of the zoologist will supplement the researches of the palæontologist; and through their properly united efforts we may hope in time to comprehend the structure of the *Palæocrinoidea* almost as perfectly as if they were yet living in our oceans.

LII.—Description of a remarkable new Form of Ophiuridæ from Ceylon. By EDGAR A. SMITH, F.Z.S.

THE specimen about to be described was presented to the British Museum in 1875 by Mr. E. W. H. Holdsworth, by whom it was collected at Ceylon.

Apparently it is closely related to the genus *Ophiothela* of

Verrill, although, in relation to the hitherto described species of that genus, it is a giant. It differs only in the fewness of hooks or prongs with which the arm-spines of all the species are provided; and the upper surface of the disk and arms displays a much finer granulation.

This species also shows some affinity with *Ophiogymna* of Ljungman, judging from the brief and insufficient description of that author. The armature of the mouth is similar, the oral and adoral shields have the same position, and neither exhibit a tentacle-scale; but the radial shields in *Ophiogymna* are almost entirely covered with the soft skin enveloping the disk, whereas in the present species they are altogether naked as in *Ophiothela*. The arms are said to be very long by Ljungman; but his description does not inform us regarding the plates, whether they are naked or covered with skin, smooth or granulated. *Ophiocnemis* of Müller and Troschel agrees with this species in the parts of the mouth, but differs in the arms, arm-spines, and covering of the disk.

Ophiothela Holdsworthii, sp. nov.

Disk circular, moderately thick, clothed with a soft skin beneath and above, except on the large radial shields; the latter are very remarkable on account of a raised keel or ridge, which extends from the inner or narrow end of the shield almost to the outer extremity, where it is most elevated, and terminates in a prominent angle; the shields are large, elongate, subtriangular, adjacent along the inner margins, except at the end, where they are slightly separated, leaving a notch between for the origin or insertion of the arm; they do not reach quite to the centre of the disk; and the inter-radial naked space between the different pairs is about equal in extent to one of the shields. *Oral shields* indistinct, small, somewhat triangular, with an angle towards the mouth between the small irregularly oval adoral scuta; teeth about three in number, irregular, small, acute at the end; *tooth-papillæ* in two series, irregular, not numerous. *Arms* 5, three and a half times as long as the diameter of the disk, slender: *lower arm-plates*, with the exception of a few near the oral end, clothed with a thin skin, and consequently rather indistinct; they appear to be very small, about as long as broad, outer and inner edges arched, the lateral margins very slightly convex; the first plates are situated between the adoral shields, are of the same size, and with them form a continuous ring around the mouth: *upper arm-plates* naked, minutely granulated, two or three times as broad as long, frequently fractured into two or more pieces, and hence more

or less irregular in form; the outer edge is either straightish, slightly convex, or undulating: *side arm-plates* in the form of narrow ridges: *arm-spines* very short, covered with skin at the base, naked and minutely prickly at the tips; four in number, except near the disk, where a few plates are armed with five; the three upper ones are subequal, and only a little more than a millimetre in length, the lowermost one very minute, and situated in a line with the tentacle-pores; and a few of them towards the end of the rays are armed with a minute hook or double hook at the extremity. No *tentacle-scale*. *Genital* rimæ furnished with a distinct irregular elongate-oval plate at the outer extremity, extending a little beyond the actual opening into the disk. The general colour of the disk above is purplish brown, somewhat paler on the keels of the radial shields, considerably paler beneath; arms light brown above and whitish below; the oral and aboral shields are of the same tint as the lower surface of the disk; the skin covering the arm-spines is purplish brown, giving the arms a bordered aspect.

Diameter of disk 25 millims., length of arm about 80, length of radial shields 10.

LIII.—*Remarks on some new Alphei, with a Synopsis of the North-American Species.* By W. N. LOCKINGTON.

THE North-American species of the old genus *Alpheus* are now known to be very numerous, as many as sixteen having been found upon the Pacific coast, from Panama northwards, making a total of eighteen species from both coasts.

Some kind of subdivision, in so numerous a group, is necessary for the sake of convenience; and the presence or absence of a rostrum and of ocular spines probably furnish characters as reliable as any.

Dana, in 1852, availed himself of the absence of a rostrum, and the inversion of the hands, to separate the genus *Betæus*, which has been generally acknowledged until Kingsley, in his synopsis of North-American species of the genus *Alpheus* (Bull. U.S. Geol. & Geogr. Surv. vol. iv. no. 1, p. 189), proposed, on what appear to me to be insufficient grounds, to reunite them.

In a large series of *A. minus*, Say, that author found many which wanted the rostrum; while in some other *Alphei* the dactylus works obliquely or horizontally, showing an approach to the characters of *Betæus*.

But is it not the case with almost every genus except such as stand alone, forming of themselves a family or subfamily, that some of the less typical species intergrade with an adjoining genus, or even with three or four adjoining genera? What is a genus? Is it not, like a species or family, a portion of the scale of Nature marked off arbitrarily for convenience in classification?

If there are rigid genera, not intergrading with others, it is because the connecting links have not yet been discovered—or because the causes which produced the generic characters were sudden and profound, destroying all races which did not change with sufficient swiftness.

The multiplicity of genera with one species has been caused in great part by the too great subdivision which has been indulged in by naturalists. Characters merely specific have been made generic, while every slight variation of form or colour has added a species. More advanced modern naturalists, reviewing these co-called species with ample material, have proved that they are merely geographical varieties of the same species; and the result has been that we have numerous single species with a full binomial to themselves, yet with little to warrant such distinction. This is especially the case among the birds of North America; and will occur in other classes as soon as our knowledge is sufficiently advanced to detect the intergradation of allied forms from different localities.

Were the test of geographical variation applied to our North-American *Alphei*, I have little doubt that many would sink into varieties. Yet the forms actually distinct are really numerous, and the genus so large that it needs subdivision. Many of the species included in it, were they classified on the same principles with birds, would become genera.

Previous to my notice of *A. bellimanus*, *A. æquidactylus*, and *B. longidactylus* (in the Proc. Cal. Acad. vol. vii. part 1, pp. 34, 35) no species had been described from this coast; immediately afterwards I added two other species; Kingsley (Bull. U.S. Geol. and Geogr. Surv. vol. iv. no. 1, p. 189) adds six new species, all occurring at Panama, and notes the occurrence of the Atlantic *A. heterochelis* at Panama and Realejo, on the Pacific coast; and in this paper I describe four additional species, noting also the occurrence of *A. heterochelis* on both shores of Lower California.

I am not aware that commensalism has previously been observed in this genus (Van Beneden, in his 'Animal Parasites and Messmates,' does not mention it), although *Pontonia*, an allied genus, is commensal; yet one at least of the Pacific species, *B. æquimanus*, is a commensal under the mantle

of the common "abalone" (*Haliotis rufescens*, Swains.). As this mollusk extends far towards the north, we may expect to hear of *B. æquimanus* from more northern localities. At present it is known only from Catalina Island and Santa Barbara, California.

As I have not in my possession any foreign species of the genus, and have not seen several of the species lately described by Kingsley, I shall in this place separate *Betæus* only, and treat of the rest of the group as one genus, divided into sections by the characters of the front and hands, for convenience in future identification.

The letter **P** indicates that the species belongs to, or has been found upon, the Pacific coast, while **A** indicates the Atlantic species.

The species I have had an opportunity to examine are marked thus, !.

Synopsis of the North-American Alphei.

A. Rostrum present.

a. Ocular spines present

A sulcus between eye-shields and rostrum :

larger hand complexly sulcated, with a superior and an external spine; dactylus swollen at the tip, working horizontally: smaller hand with a superior spine. Meral joints of posterior pairs with a spine below; propodi spinulose

A. clamator ! **P**.

No sulcus between eye-shields and rostrum :

larger hand as in *clamator*; dactylus laminate, closing horizontally: smaller hand with superior and exterior spines. No spines on meral joints of posterior pairs; propodi spinulose

A. bellimanus ! **P**.

No spine on basal joint of antennæ: larger hand with superior and external spines, sulcate; dactylus vertical (?): smaller hand with superior spine. Posterior pairs without meral spines; propodi spinulose

A. barbara *, **P**.

Antennal scale regularly elliptical; larger hand a third longer than carapax, with a spine above and a smaller one near it.

Propodi of posterior pairs spinulose . . .

A. minor ! **A**.

Basal spine of antennulæ reaching to end of second joint of antennular peduncle; smaller hand (?) without spines. Penult. joint of abdomen with lateral spines. . .

A. æquidactylus ! **P**.

Orbital spines arising from superior surface of carapax, margin continuous beneath them; larger hand spineless; smaller

* = *A. clamator*, Kingsley.

- ditto, slender. Propodal joints of posterior pairs spinulose *A. panamensis*, P.
- Larger hand elongate, spineless, slightly sulcate; smaller slender, spineless. No spines or spinules on posterior pairs. Two pairs of spinules on telson *A. tenuimanus* ! P.
- Basal spine of antennulæ reaching to middle of second joint of peduncle; basal joint of antennæ with a small upper and large lower spine; larger hand without spines or sulci; smaller ditto. Posterior pairs without meral spines; propodi spinulose. *A. leviusculus* ! P.
- b. No ocular spines.
- Eye-shields produced forwards, scarcely spiniform; larger hand spineless, sulcate, thumb distorted, smaller (♀) *A. sulcatus*, P.
- Rostrum separated from ocular shields by a deep depression: larger hand once and a half as long as carapax, spineless, constricted; dactylus slightly oblique, with large basal tooth: smaller hand spineless; fingers about equal to palm. Posterior pairs with spinulose propodi. . . *A. heterochelis* ! A, P.
- Rostrum separated from eye-shields by a sulcus: larger hand with a superior spine, sulcate; dactylus as in *heterochelis*, but obtuse: smaller hand as in *heterochelis*. . . *A. affinis*, P.
- Carina of rostrum running back to nearly middle of carapax; larger hand once and a half as long as carapax, spineless; smaller hand as long as larger, spineless, fingers longer than palm *A. floridanus*, A.
- Carina of rostrum continued backwards, but no depression between eye-shields and rostrum: larger hand spineless, sulcate; dactylus vertical: smaller hand spineless. Meral joints of posterior pairs spineless; propodi spinulose. Telson with two pairs of spinules above and a third pair at tip *A. spinicaudus* ! P.
- Hands small, nearly equal; larger spineless, constricted on margins; smaller slender, fingers equal to palm. No meral spines on posterior pairs. *A. parvimanus*, P.
- Hands very unequal; larger spineless, cylindrical, tapering; smaller smooth, slender, cylindrical, dactylus as long as palm. No meral spines on posterior pairs; propodi spinulose *A. fasciatus* ! P.
- Rostrum very short, obtuse; no spine on basal joint of antennæ. Larger hand cylindrical, grooved externally: dactylus horizontal; smaller hand cylindrical; fingers equal to palm *A. cylindricus*, P.
- B. Rostrum wanting; dactylus on lower side of hand. = *Betæus*, Dana.
- Front emarginate between eyes; hands nearly

equal, compressed-ovate, spineless. Dactylus of posterior pairs spinulose *B. æquimanus*! P.
 Front rounded; hands similar, fingers gaping widely *B. longidactylus*! P.

Alpheus clamator, Lockington.

Alpheus clamator, Lockington, Proc. Cal. Acad. Sci. vii. 1876, p. 43.

Alpheus transverso-dactylus, Kingsley, loc. cit. p. 197.

Carapax smooth, body not greatly compressed. Front tri-spinose; the rostrum longer and more slender than the ocular spines, which are separated from it by a deep sulcus, and widen out quickly into the eye-shield.

Basal spine of antennulæ shorter than the first joint of the peduncle; outer branch of flagella stout, margined with setæ, about equal in length to peduncle, inner branch about half the length of the body.

Antennæ with a spine on basal joint. Antennal scale narrow; its spine nearly, and its laminar portion quite, reaching the end of the antennary peduncle, which is slightly longer than that of antennulæ. Flagella more than three quarters the length of body.

External maxillipeds extending slightly beyond peduncle of antennæ. Meros of both hands of first pair smooth, compressed, with a slender spine at distal extremity above. Carpus of smaller hand slightly longer than that of larger. Hands unequal, dissimilar. Fingers of smaller pair straight, parallel, slender, closely fitting, working vertically, about equal in length to palm; manus with a spine above articulation of dactylus, whole inner surface beset with long hairs. Larger hand smooth proximally, setose and complexly sulcate distally. A large spine on the outer side continued backward as a carina, above the carina a deep sulcus; a second spine at articulation of dactylus. A deep and wide sulcus commencing above the articulation of the dactylus, flanked internally by a sharp ridge, externally by a smooth, broad ridge separating it from the exterior sulcus. This superior sulcus is continued obliquely backwards along the upper surface of the hand; and from about the centre of its length a transverse constriction is continued down the inner side of the hand. Below the exterior spine a constriction divides the pollex from the palm. Dactylus short, curved so as to close horizontally, swollen at the extremity, extending beyond the pollex. Ischium and meros of second pair equal; carpus five-jointed, first four joints together equal to meros, third and fourth joints each half the length of the second, which is equal to the first; fifth joint intermediate in length between

second and third; hand as long as fourth and fifth carpal joints.

Meral joint of posterior pairs with a spine at distal extremity beneath; propodal joints of all three posterior pairs spinulose beneath.

Telson broad, rounded at extremity.

Length 1.05 inch.

Colour, in alcohol, a light flesh tint, much deeper on the large hand. A darker spot on the upper surface of the carapax, also on the anterior edge of the first two abdominal segments.

This species lives in pools on rocky reefs at low-tide level, and is capable of producing, by clapping together the fingers of the larger hand, a snapping noise like that which can be made with the finger-nail.

Loc. Santa-Barbara Island (*S. A. L. Brannan*); San-Bar-tolomé Bay, W. coast Lower California (*W. J. Fisher*).

The above description is considerably amplified from the short and incomplete one published in the *Proc. Cal. Acad. Sci.*

Kingsley's description of his *A. transverso-dactylus* tallies exactly with my descriptions and with the specimen of *A. clamator* (a female) in my collection. His *A. clamator* differs from this in the want of a spine on the basal joint of the antennæ, in the proportions of the carpal joints of the second pair, in the want of a spine on the meral joints of the posterior pairs of limbs, and in the details of the hands.

A. bellimanus is near this species; but the rostrum is longer, there is no sulcus between eye-shields and rostrum; the dactylus of larger hand is not swollen at the tip, and works horizontally; the palmar portion of the smaller hand is not unlike that of the larger, and has two spines in the same positions as those on the larger; the dactylus is thin and laminate; and the meral joints of the posterior pairs have no spine below.

Alpheus bellimanus, Lock.

Alpheus bellimanus, Lock. *loc. cit.* p. 34.

Carapax slightly compressed; front three-spined, rostrum longest; no sulcus between eye-shields and rostrum; basal spine of antennulæ short, not reaching second joint of peduncle, second joint twice as long as third; inferior branch of flagella twice as long as the superior.

A small spine on basal joint of antennæ; spine of basal scale about as long as peduncle; flagella twice the length of the carapax. External maxillipeds longer than peduncles.

Feet of first pair unequal. Larger hand constricted above the hind articulation of dactylus; a longitudinal groove continued backwards from this constriction on outer side of hand for about half its length, and a second shorter sulcus running backwards close inside the upper margin of hand; a second transverse constriction posterior to the upper one, on the lower margin; from this a longitudinal sinuous sulcus is continued forward to the extremity of the pollex. A sharp spine on the distal end of the ridge separating the anterior portion of the upper outer longitudinal sulcus from the posterior portion of the lower one. A spine at articulation of dactylus. Dactylus broad, thin, and articulated, so as to close horizontally above the point of the pollex, which is very short and irregular in outline; a few long hairs on dactylus and thumb. Smaller hand compressed, constricted above and below; a spine on outer surface at base of dactylus, and a second on upper margin at articulation of dactylus; dactylus laminate, working vertically with a straight lower margin; pollex slender; distal portion of hand and inner surface of dactylus hairy.

Carpus of second pair five-jointed; first joint nearly equal to the next three; second and fifth subequal, each nearly as long as the third and fourth together.

Meral joints of remaining pairs without a spine beneath; propodi spinulose beneath.

Telson tapering, convex at extremity.

Length of larger specimen, from tip of rostrum to end of abdomen, 1.20 inch; length of larger hand half an inch, of smaller 0.38 inch.

Loc. Two specimens from San Diego, found among kelp.

The dried specimens, when comparatively fresh, have the hands beautifully coloured with spots and markings of black and white on an orange ground; and the carapax presents traces of similar coloration.

Alpheus barbara, Lock.

Alpheus clamator, Kingsley, Bull. U.S. Geol. & Geogr. Surv. vol. iv. no. 1, p. 197.

This species, supposed by Kingsley to be identical with my *A. clamator*, is proved by the absence of a spine on the basal joint of the antennæ, the different proportions of the carpal joints of the second pair, and the want of meral spines on the posterior pairs (characters belonging to parts not described in my notice of *A. clamator*) to be quite distinct from the latter; and I have therefore assigned it the name of *A. barbara*,

from the locality (Santa Barbara, California) where Kingsley's specimens were collected. The details of the hands also differ.

From *A. bellimanus* this species may be distinguished by the presence of a slender spine on the distal extremity of the meral joints of the first pair, by the want of the antennal basal spine, the less complex sulcation of the larger hand, the absence of an external spine on the smaller hand, and the equal length of the first two carpal joints of the second pair.

As Kingsley had only an imperfect specimen, and does not describe the rostrum and front, I cannot be sure that this species belongs to this section.

Alpheus minor, Say.

Alpheus minus, Say, Journ. Acad. Nat. Sci. 1818, i. p. 245; Edwards, Hist. Nat. des Crust. ii. p. 356; De Kay, New York Fauna, Crust. p. 26; Gibbes, Proc. Am. Assoc. Adv. Sci. 1851, p. 196; Kingsley, Bull. U.S. Geol. & Geogr. Surv. vol. iv. no. 1, p. 190.

Alpheus formosus?, Gibbes, *loc. cit.*

Kingsley believes *A. formosus* identical with *A. minor*: the range of variation, both in size and in rostral characters, appears to be great; and as it occurs along a great length of coast, it is not unlikely that distinct geographical varieties may be made out.

Alpheus æquidactylus, Lock.

Alpheus equidactylus, Lock. Proc. Cal. Acad. Sci. vol. vii. pt. 1, p. 35.

Front trirostrate, without sulcus between rostrum and ocular spines; the latter short, not greatly in advance of the eyes, the former extending slightly beyond first joint of antennular peduncle.

Basal spine of antennulæ stout, extending to end of second joint of antennular peduncle; joints of the latter subequal; flagella — ?

Basal joint of antennæ with a small spine below; spine of antennal scale overpassing antennular spine by about one fourth of its length, but not extending to tip of antennular peduncle. Antennal peduncle intermediate in length between the antennular spine and that of antennal scale; flagella — ?

External maxillipeds about equal to peduncle of antennæ.

Smaller (?) hand elongate-ovate, smooth, without spines, but with a transverse sulcus behind articulation of dactylus; a deep narrow longitudinal sulcus continuing backwards from the transverse sulcus for two thirds the length of the palmar portion: pollex with two teeth near base; tip recurved,

pointed. Dactylus articulated vertically, smooth, compressed, with a tooth near base fitting between those of the pollex; tip recurved, pointed, crossing that of pollex.

Carpal joints of posterior pairs produced into a blunt spine above distally; no spine on meral joints; propodi without spinules.

Penultimate joint of abdomen with a spine, apparently movable, at lower angle, and a triangular projection on each side of base of telson, which is smooth, somewhat tapering, convex at extremity.

Length of body 19 millims, of hand 7.5 millims.

This description is taken from a single dried, broken, and defective specimen from Monterey, California (*H. Hemphill*). The flagella of both pairs of antennæ are broken; one hand, probably the larger (?), is wanting, the other hand detached; and the second pair is wanting.

In my previous description (*loc. cit.*) I mention the larger hand; but it is probable that the member thus called is the same as that I now think, from its small size, to be the smaller hand.

Alpheus panamensis, Kingsley.

Alpheus panamensis, Kingsley, *loc. cit.* p. 192.

Loc. Acajutla, Central America, and Panama (*F. H. Bradley*).

Alpheus tenuimanus, nov. sp.

Carapax smooth, compressed, and arched in profile, much highest in centre. Front trispinose; rostrum much longer than ocular spines, reaching to middle of second joint of peduncle of antennulæ; ocular spines slender, projecting from the centre of the convex front of the eye-shields.

Basal spine of antennulæ reaching beyond the first joint of the antennular peduncle; upper branch of flagellum about as long as carapax; lower — ?

A spine on basal joint of antennæ below; antennal scale equal to peduncle of antennæ; flagellum not shorter than abdomen.

External maxillipeds reaching beyond the antennal scale, with long hairs at tip.

Hands equal in length, not greatly differing in size, dissimilar.

Meros of first pair compressed, somewhat triangular, rounded above, with a small spine above at distal end. Larger hand elongated, entirely smooth, rounded above and below; proxi-

mal extremity slightly broader than distal; a shallow sulcus, with a shorter one above, extending obliquely upwards from the carpal articulation on the inner side of the hand; dactylus short, smooth, compressed, semicircular in outline when viewed from the side, slightly overpassing the pollex, working vertically, and closing in groove in pollex, bright red at tip (in alcohol). Smaller hand with meros similar to larger; manus exceedingly elongated, smooth, cylindrical; dactylus almost as long as palmar portion of hand, slightly curved, working vertically, slightly overpassing the long and slender pollex. Both dactyli are somewhat setose on their opposed outer margins.

Ischium and meros of second pair about equal; carpus with five joints, the first joint about equal to the next three united, second slightly longer than the third and fourth, which are equal; fifth, palmar portion of hand, and dactylus about equal, and each about equal to the second joint.

Posterior pairs without spines or spinules on any of the joints.

Telson elongate, slightly tapering, with four spinules, in two pairs, on its upper surface, and a spine on each side of its convex truncate extremity, which is margined by long setæ.

Length 34 millims.; length of larger hand 10, of carapax 13 to tip of rostrum.

A single specimen, with the antennæ and antennulæ damaged, from Port Escondido, Gulf of California (*W. J. Fisher*), is my only example of this species, which may easily be distinguished from its congeners by its long rostrum, smooth hands of equal length, and especially by the two pairs of spinules upon the telson.

Alpheus læviusculus, nov. sp.

Carapax stout, not compressed. Front trispinose, the ocular spines triangular, almost equal in length to the triangular rostrum, which is not divided from the eye-shields by a sulcus. Basal spine of antennulæ stout, reaching to the middle of the second joint of the peduncle; inferior branch of flagella two thirds longer than superior, which only slightly exceeds the peduncle in length.

Basal joint of antennæ with two spines, the upper one small, the lower almost half the length of the spine of the antennal scale, which does not reach to the end of the peduncle; flagellum short, reaching, when extended, slightly beyond the larger hand.

First pair very unequal in size. Meros of smaller hand compressed, with a spine at the upper distal end; hand about

equal in length to meros, smooth, ovate; dactylus in the same plane with the hand; pollex slightly hooked at tip.

Meros of larger hand less compressed than that of smaller; a small spine at upper distal end; manus broad, stout, entirely smooth, ovate, terminating abruptly in a sinuate distal margin, from the lowest point of which projects the short, broad, spoon-shaped pollex. Dactylus short, stout, curved, overpassing the pollex, with a large basal tooth fitting into a groove in the latter. Dactylus and pollex of both hands blue, becoming black at the tips. Meros of second pair longer than the ischium; carpus five-jointed, first joint nearly as long as the other four; second, third, and fourth joints equal, and two of them equal to the fourth; hand about equal to third and fourth joints.

Meral joints of posterior pairs without spines; propodi spinulose beneath; dactyli bifid at tip, the upper spine longer than the lower.

Telson with sinuate margins, arcuate posteriorly.

Length of largest specimen 30 millims., carapax 10, larger hand to tip of dactylus 11. ♀.

Several specimens from Port Escondido, Mulege Bay, and other points on the Californian shore of the Gulf of California.

Alpheus sulcatus, Kingsley.

Alpheus sulcatus, Kingsley, *loc. cit.* p. 193.

Bay of Panama. Zorritas, Peru (*F. H. Bradley*).

Alpheus heterochelis, Say.

Alpheus heterochelis, Say, *Journ. Acad. Nat. Sci.* 1818, p. 243; Edwards, *Hist. Nat. des Crust.* tome ii. p. 356; De Kay, *New-York Fauna*, Crust. p. 26; Gibbes, *Proc. Am. Assoc. Adv. Sci.* p. 196; Kingsley, *loc. cit.* p. 194; Smith, *Trans. Conn. Acad.* ii. pp. 23, 39.

Alpheus armillatus, Edwards, *op. cit.* ii. p. 354.

Alpheus lutarius, Saussure, *Crust. Nouv. des Antilles et du Mexique*, p. 45, pl. iii. f. 24, 25; Martens, *Wiegmann's Archiv für Naturgeschichte*, 1872, p. 139.

Halopsyche lutaria, Saussure, *Rev. Zool.* 1857, p. 100 (*teste* Saussure).

Halopsyche bispinosus?, Streets, *Proc. Ac. Nat. Sci. Phil.* 1871, p. 242.

This appears to be one of those forms, occasionally met with in every zoological class, that have changed so slightly in accommodating themselves to their environment as to be at once recognizable as the same species.

Specimens collected in various localities in Lower California present no appreciable difference from the typical *heterochelis*, of which I have a specimen from Folrida. This specimen lacks the smaller hand.

Kingsley (*loc. cit.*) says of the smaller hand:—"cylindrical, constrictions but faintly indicated; fingers three fourths as long as palm."

In my specimens the dactylus is about equal in length to the palmar portion of hand behind it, and there is a projection, almost amounting to a blunt spine, on the inner side at origin of dactylus. There is no spine at the distal end of the meral joints of the posterior pairs, which have the propodi spinulose beneath.

The interior of the hands becomes more hirsute with age, many of the smaller specimens having only a few hairs on the fingers, while in some of the larger the distal portion of the hand is densely hairy.

The larger individuals, on examination after only a few weeks' exposure to alcohol, showed traces of a varied coloration; the tips of the fingers were black.

Length of a large specimen 37 millims. A specimen 30 millims. long has the larger hand 15 millims.

Kingsley gives the following localities:—

Fort Macon, N. C. (*Dr. H. C. Yarrow*); Smyrna and Key West, Fla. (*A. S. Packard, Jun.*); Lake Harney, Fla.; Bahama Islands (*G. B. Goode*); Bermuda Islands (*G. B. Goode*); Aspinwall (*J. A. M'Niel*); Abrolhos, Brazil (*C. F. Hartt*); Panama (*F. H. Bradley*); Realejo, W. C. Nicaragua (*J. A. M'Niel*).

I have specimens from La Paz; San-José Island, Amortiguado Bay; Mulege Bay and Port Escondido: all on the gulf coast of Lower California. Also from Magdalena Bay, west coast of Lower California.

Alpheus affinis, Kingsley.

Alpheus affinis, Kingsley, *loc. cit.* p. 195.

This appears to be very near indeed to *A. heterochelis*.

Loc. Panama (*F. H. Bradley*).

Alpheus floridanus, Kingsley.

Alpheus floridanus, Kingsley, *loc. cit.* p. 193.

Loc. Fort Jefferson, Florida (*Lieut. Jacques, U.S.N.*).

Alpheus spinicaudus, nov. sp.

Rostrum very short, continued backwards between the eye-shields as a low carina; no ocular spines.

Spine at base of antennulæ nearly as long as basal joint of peduncle; second joint of peduncle one half longer than third,

which is about equal to first; outer branch of flagellum, including its slender terminal portion, nearly equal to inner, which is about equal to carapax.

Spine of antennal scale longer than laminar portion or than peduncle of antennulæ, and equal to antennal peduncle; flagellum twice the length of the carapax.

External maxillipeds longer than peduncle of antennæ; terminal joint margined with setæ, those at tip very long.

Meros of first pair spineless, that of smaller hand concave on outer surface.

Hands of first pair unequal, dissimilar. Larger hand compressed, smooth, constricted above and below; at about the distal third of its length a sulcus, broad at commencement, but rapidly narrowing, running backwards longitudinally at right angles to the upper constriction on both outer and inner faces. Dactylus short, working obliquely, with a stout basal tooth, closing in a deep groove in the pollex; the blunt tip of the dactylus crossing the sharp extremity of the thumb. Smaller hand rounded, smooth; dactylus half the length of palm, working vertically, and equal to the pollex; tips of dactylus and pollex sharp, curved inwards, and crossing each other. Inside of both hands setose towards distal end, especially the smaller.

Ischium and meros of second pair equal; carpus five-jointed, second joint two thirds longer than the first, and longer than third and fourth together, third and fourth equal, fifth and first about equal.

Meral joints of posterior pairs without spines; propodal joints spinulose beneath.

Telson elongate; sides tapering; end slightly convex; two pairs of spinules on the upper surface, and a third pair projecting from the extremity, which is fringed with long setæ between the posterior spinules.

Prevailing colour of specimens, after six months' exposure to alcohol, red; antennæ blue.

Length of the largest female 22 millims.; length of larger hand 8 millims.

Several specimens from Port Escondido, Gulf of Cal. (*W. J. Fisher*), collected in July to August 1876; the females loaded with ova.

Alpheus parvimanus, Kingsley.

Alpheus parvimanus, Kingsley, *loc. cit.* p. 195.

Loc. Panama (*F. H. Bradley*).

Alpheus fasciatus, nov. sp.

Small; carapax smooth; no ocular spines; eye-shields scarcely produced forwards; rostrum about equal to diameter of eye; surface between rostrum and eyes slightly depressed, but with no distinct sulcus.

Basal spine of antennulæ longer than basal joint of peduncle; joints of peduncle nearly equal in length; inner branch of flagellum twice as long as outer, and rather longer than carapax.

A small spine on basal joint of antennæ below; spine of basal scale about equal to peduncle; flagella wanting or broken in all the specimens under examination.

External maxillipeds reaching to end of basal joint of antennæ.

Meros of first pair without spine; larger hand smooth, nearly cylindrical, tapering towards the dactylus, which is smooth, semicircular in profile, a fourth the length of the palm, and works vertically. Smaller hand very small, smooth, cylindrical, slender; dactylus equal to palm; pollex as long as dactylus; long hairs on inner side of fingers.

Carpus of second pair five-jointed; second joint two thirds the length of first, but equal to third and fourth together; fifth a little shorter than second. Posterior pairs with cylindrical joints; propodal joints spinulose beneath.

Telson elongate, tapering, rounded at end.

Colour after a short time in alcohol:—carapax and abdomen alternately banded with bright red and white; larger hand red, with marblings of white in some cases.

Length of a large female 18 millims.

Several specimens from Port Escondido, Gulf of Cal. (Fisher).

Alpheus cylindricus, Kingsley.

Alpheus cylindricus, Kingsley, loc. cit. p. 196.

From its short obtuse rostrum this form approaches *Betæus*. Loc. Pearl Island, Bay of Panama (F. H. Bradley).

Betæus æqualis.

Betæus equimanus, Lockington, Proc. Cal. Acad. Sci. vol. vii. p. 43.

Alpheus æqualis, Kingsley, N.-Amer. Species *Alpheus*, Bulletin U.S. Geol. and Geogr. Survey, vol. iv. no. i.

Carapax smooth, compressed; front curvately emarginate between the eyes.

Outer maxillipeds as long as base of inner antennæ; setæ of terminal joint long and closely set.

Basal scale of antennulæ a slender spine, reaching beyond the middle of the second joint of the peduncle. Second joint of the peduncle nearly twice as long as the last joint; peduncle slightly shorter than that of antennæ. Outer branch of flagellum about two thirds the length of the inner.

Antennal scale with long slender spine, the laminate portion reaching about to end of peduncle. Antennæ without spine on basal joint; flagellum more than half the length of body.

"Meros of first pair trigonal, with small spine at upper distal angle."

Hands nearly equal, entirely smooth, compressed, ovate; dactylus with a sharp recurved point and a straight edge, margined with setæ; this is opposed to a similar straight edge, margined with setæ, on the pollex, which also ends in a sharp incurved point. The dactylus of both hands has a basal tooth. The fingers gape slightly at the proximal end.

Feet of second pair slenderer than third and fourth, but not greatly longer; "ischium slightly shorter than meros; carpus five-jointed: first joint as long as the three succeeding ones; second, third, and fourth equal; fifth slightly longer. Chela about as long as the two preceding joints.

"Dactyli of posterior pairs spinulose at tip.

"Telson slender, tapering; extremity regularly rounded."

Length of larger specimen 1.05 inch.

Two specimens examined, both females with ova; Catalina Island, Cal. (*S. A. L. Brannan*).

This species lives under the mantle of *Haliotis rufescens*, Swains.

Colour, when fresh, dark purple; in alcohol, a light flesh tint.

I have here supplemented the short description given in the Proc. Cal. Acad. Sci., with others taken from Kingsley's description of *A. Harfordi*, and verified by reexamination under the microscope, the previous examination having been made with hand-lens only. I cannot find the "notch furnished with two or three small teeth near the articulation of the dactylus," mentioned by Kinglsey as existing upon the pollex of the larger hand; perhaps his specimens were males.

Kingsley gives the following dimensions:—

Length. millim.	Carapax. millim.	Larger hand. millim.	Larger dactylus. millim.
24.0	8.0	8.0	4.7
19.0	6.0	6.0	3.6

My reexamination of the specimens has convinced me that

Kingsley's *Alpheus Harfordi* is identical with my *B. equimanus*.

Betæus longidactylus.

Betæus longidactylus, Lockington, Proc. Cal. Acad. Sci. vol. vii. p. 35.
Alpheus longidactylus, Kingsley, loc. cit. p. 198.

Carapax smooth, much compressed, "front rounded; antennular spines slender, acute. First and second antennular joints subequal, third shorter; inner flagellum three fourths the length of carapax; outer——?"

"Antennal scales shorter than peduncles of either pair of antennæ.

"External maxillipeds extending nearly to extremity of antennal peduncle."

Hands of first pair similar, long and compressed; pollex forming half the length of the manus; dactylus more than half that length; the fingers when closed gape widely, both are pointed at the end, and the points cross each other like the mandibles of a *Loxia*. At the base of the dactylus are several teeth opposed to two large ones on the manus, which also bears a large tooth in the centre of the pollex.

"Carpus of second pair five-jointed; first joint as long as the three following; second, third, and fourth equal; fifth slightly longer.

"Extremity of telson rounded."

Colour of carapax of dried specimen green, with nuances of russet and olive. Fingers of the larger hand light red, the tips green. Length of carapax 1.12 inch, of larger hand 0.56, of smaller 0.36.

As in the description of the previous species, the portions within quotation marks are from Kingsley. The single specimen in the museum of the Academy came from a sandy mud flat, San Diego, California, between tide-marks.

San Francisco, April 4, 1878.

LIV.—*Descriptions of two Butterflies collected by Dr. Turner at Port Moresby, New Guinea.* By ARTHUR G. BUTLER, F.L.S. &c.

Danaïs Turneri, n. sp.

♂ ♀. Dark olive-brown, with semihyaline pale green markings, almost as in *D. purpurata*, but differing as follows:—primaries with three small spots, instead of two large ones and a dot, across the end of the cell; the four spots just

beyond the cell of double the size; the spots of the forked discal series of nearly equal size throughout and continued to the interno-median interspace near anal angle; a series of six minute white dots near the outer margin: secondaries with no spot between the first and second median branches, and the spot between the radial and the third median branch truncated at the end; abdominal area with the ground-colour pale brown. Expanse of wings 3 inches 2 lines.

More falcate than *D. purpurata*; in some respects nearer to *D. sobrina* and *D. meganira*.

Neptis cyanifera, n. sp.

Wings above black, bluish towards the base: primaries with a semicircular blue patch about the middle of the inner margin, and a round white spot above it, surrounded by blue scales, upon the first median interspace; a white subcostal dot just beyond the cell; two subapical white discal spots placed obliquely, and a submarginal series of six white or whitish small spots: secondaries crossed before the middle by an irregular quinquelfid white stripe enclosed in a rather broad blue belt; three or four bluish dots parallel to the outer margin. Wings below chocolate-brown: primaries below with all the spots white, all excepting those of the submarginal series (which contains eight small spots) pearly; an additional spot near the end of the cell: secondaries with the base broadly sordid white, crossed by a blackish bar; a pearly white belt before the middle of the wing; a submarginal series of pinky white spots and a marginal series of longitudinal pinky white dashes. Expanse of wings 2 inches 2 lines.

Allied to *N. Brebissonii*, *N. mortifacies*, and *N. lactaria*.

LV.—On the Nauplius Stage of Prawns.

By Dr. FRITZ MÜLLER*.

AFTER the appearance of the essay on the metamorphosis of the Prawns †, Spence Bate expressed to me his doubts on the connexion of the young forms described by me. Properly one should never refer larvæ to definite grown-up animals unless obtained from the ova and the latter from the parent. My *Nauplii* had been caught while swimming freely in the sea, and possibly might not be the larvæ of *Penæus* at all.

* Translated from 'Zeitschrift f. wiss. Zool.' Bd. xxx. p. 163.

† Archiv für Naturgeschichte, xxix. 1, 1863, p. 8.

Alexander Agassiz has since expressed himself similarly; and I also find the same doubts repeated by Dr. Paul Meyer* in a criticism of Claus's latest work ('Investigations for the Discovery of the Genealogical Foundation of the Crustaceous System').

The development of *Nauplius*-like larvæ into Macrurous Crustacea is of such importance to the genealogy of the Crustacea that it does not seem superfluous to point out once more the reasons which induce me even now to look upon the course of development described by me as a completely assured fact. I repeat, for this reason, literally, what I wrote in October 1864 as a reply to Spence Bate's doubts.

The requirement that one should only ascribe early forms to definite parents when one has obtained them from the ova taken from the parent, seems to me to be unreasonable.

If one admitted that, it would naturally be demanded not only for the earliest forms, but, with equal justice, for all young (intermediate) forms. It would be necessary to demand for every stage either that it be reared from the ovum or preserved alive until it arrives at sexual maturity; and this condition would compel us to give up the study of the development of most marine animals. I contend that it is quite enough that we should be able to unite the terminal members of the series by a continuous chain of intervening forms so closely united that there cannot be any reasonable doubt about the connexion of any two successive forms. But the proof of the connexion of my *Nauplius* with the *Penceus*, or a genus nearly related to it, I believe to have been established in a sufficient manner.

In a journal which has only twelve plates in a year I could not, as Spence Bate has done for his memoir on the development of *Carcinus mænas*, obtain seven plates for one essay. I had therefore to limit myself to illustrating only a few of the most interesting forms out of fifty pages of drawings of the development of the prawns produced from the *Nauplius* stage.

At the same time it appeared to me unnecessary to remark that the metamorphosis of one form into the other had not been imagined, but was the result of close observation of numerous larvæ.

Only in one place there were not at my command intervening forms in abundance.

Between the *Nauplius* (pl. ii. fig. 2) and the *Zoëa* represented in fig. 4 I had only one opportunity of observing (in the same species) two intervening forms, which I mentioned—

* Jenaer Literaturzeitung, 1877, No. 16, p. 247.

an older *Nauplius* whose third pair of legs I drew in fig. 3 (in four specimens), and one younger *Zoëa*.

But as it is just against this point, and, as far as I know, against this point exclusively, *i. e.* against the relation of the *Nauplius* with the *Zoëa*, that the doubts are directed of those who cannot believe in the metamorphosis of a *Nauplius* into a long-tailed crustacean, I will once more place together the peculiarities in which the oldest *Nauplius* agrees with the youngest *Zoëa*.

In the first place, they have the same highly peculiar mode of movement, by which they are distinguished at once from all other marine Crustacea.

In the second place, they have the same colour. The two anterior pairs of limbs and the fork-like caudal extremity especially show a peculiar brown colour deepening towards the extremity, which I do not find in any other Crustacea of our sea.

In the third place, the proportional length and the whole appearance of the first two pairs of limbs are the same; only they are more distinctly articulated in the *Zoëa*, and the second pair is more profusely ciliated: instead of three hairs on the end of the inner branch, there are four. Likewise the posterior extremity of the *Zoëa* differs only in having the two branches further asunder, and in having first seven and still later eight hairs on each branch, instead of six as in the oldest *Nauplius*.

In the fourth place, from the structure of the third pair of limbs (fig. 3) of the oldest *Nauplius* it is evident that after the next change of skin it must have mandibles with an acute, prominent tooth, and a broad, transversely furrowed masticatory surface, and that the mandible must bear a dark brown, non-setigerous appendage. The youngest has such a mandible, and bears such an appendage; and it may be remarked that the *Nauplius* was observed on the 24th of January, and the *Zoëa* on the 3rd of January, when I had no idea of the significance of this appendage to the mandible. I am acquainted with no similar appendage in any other Crustacean, young or old.

In the fifth place, we see in (*i. e.* from the structure of) the oldest *Nauplius*, that the next stage of development must possess four more pairs of limbs; the youngest *Zoëa* does possess four more pairs of limbs, corresponding in form to the rudiments present in the *Nauplius*.

In the sixth place, the formation of the heart, intestines, and liver is exactly the same in the oldest *Nauplius* and youngest *Zoëa*.

In the seventh place, in the oldest *Nauplius*, on each side

near the frontal margin was seen an opaque mass of minutely granulose texture, and extending beyond it a small round tubercle. The same is observable in the youngest *Zoëa*. From this mass are developed at a later period the paired eyes; and on them the tubercle is retained as far as the *Mysis* stage (fig. 9, *o*). I know of no other Crustacean with any such tubercle.

And with all these points of resemblance, what then are the differences? That the *Zoëa* is a little larger—that the carapace, already indicated in the *Nauplius*, is well developed—that the feet present as rudiments have come into action—that a few new setæ have been added,—steps in advance, every one of which might have been predicted.

I should have supposed that these reasons would pretty well suffice to convince the most obstinate doubters. However, if my *Nauplius* be not derived from a *Penæus*, and is not to become a *Penæus*, let them tell me what possibly it can be. The child must surely have a father. Still less than to the prawns would one assign it to any other Crustacean of the Malacostracous division, whether a crab or a woodlouse. Considering that the Phyllopods are wanting in our seas, there remain but the Copepoda, with the Lernæans, and the Cirripedes, with the Rhizocephala as the possible termination of its development.

It is impossible for it to become a Cirripede or a Rhizocephalan; the formation of the heart, liver, and mandibles suffice to demonstrate this. In addition it wants the frontal horns of the Cirripede-larvæ, as well as the spines (*Zacken*) and teeth, with which the third pair of limbs of the *Nauplius* of the Cirripedes is armed. When near passing into a second developmental stage, as the *Nauplius* represented in fig. 2 (*l. c.*) is, we should see in a Cirripede or Rhizocephalan six new pairs of feet under the skin, but not four of them sprouting forth freely on the ventral surface &c. It resembles certain *Nauplius*-forms of the Copepoda much more than those of the Cirripedes. In these also there occur stages of development in which, besides the three original pairs of limbs, rudiments of four new pairs are to be seen. But I do not know from my own experience, nor can I find among the numerous figures which adorn Claus's admirable work on the Copepoda, any form of mandible which could be compared to that of our *Nauplius*. Moreover, in all the marine Copepoda except the Corycæidæ, the third pair of limbs remain a well-bristled mandibular appendage. But, apart from this, the Corycæidæ have no heart such as our *Nauplius* possesses. To this we must add that the *Nauplius* reaches the length of half a

millimetre; it should therefore be considered rather a matured Copepod than the earliest form of such a one. If it belongs to a Copepod it must spring from an unknown gigantic species of a still unknown family; and it is rather strange that this gigantic species has not once fallen into my net during the course of many years.

Itajahy, St. Catherina, Brazil.

June, 1877.

LVI.—Notes on a Collection of Japanese Sea-Fishes.

By Dr. A. GÜNTHER, F.R.S.

A COLLECTION of fishes, formed by H. Batson Joyner, Esq., at Tokei, Japan, and presented by him to the British Museum, contained an unusually great proportion of interesting species, several of which are identical with those collected during the expedition of H.M.S. 'Challenger' and noticed in Ann. & Mag. Nat. Hist. 1877, xx. p. 433, whilst a few others appear to be undescribed and will be noticed hereafter.

This collection offers additional confirmation of a fact to which I have repeatedly drawn attention in the 'Catalogue of Fishes' and on subsequent occasions, viz. that there exists the greatest similarity between the marine fauna of temperate Japan and that of the Mediterranean and adjacent parts of the Atlantic, Mr. Joyner's collection containing not less than eight species identical in both seas, viz. *Rhina squatina*, *Pteroplatea hirundo*, *Beryx splendens*, *Beryx decadactylus*, *Hoplostethus mediterraneum*, *Trachurus trachurus*, *Brama Raii*, *Exocoetus lineatus*.

Sebastes Joyneri, sp. n.

D. $\frac{13}{15}$. A. $\frac{3}{7}$. L. lat. ca. 60.

The height of the body is equal to the length of the head, and one third of the total length (without caudal); scales very thin, scarcely serrate, a little smaller above the lateral line than below it; on the upperside of the head they advance to the nostrils and cover the præorbital and maxillary. Snout short, three fourths of the diameter of the eye, which is three tenths of the length of the head, and exceeds by one third the width of the interorbital space, which is flat. Upper surface of head smooth, scarcely armed, the two occipital ridges very low and terminating in short spines; præorbital with two flat spines; præoperculum with five spines,

the second from above being the longest, and one third of the diameter of the eye ; operculum with two spines, the upper of which is the longest. Teeth in narrow villiform bands, in the jaws, on the vomerine and palatine bones ; the vomerine teeth form a triangular patch. The maxillary does not reach to the vertical from the middle of the eye. The fourth dorsal spine is the longest, twice and a quarter in the length of the head. Anal spines stronger than those of the dorsal, the second anal spine being shorter than the third dorsal. Probably red (in life), with five brown cross bars on the back and the dorsal fin, the three anterior ones descending a little below the lateral line. Fins immaculate. Pharynx uncoloured.

Two specimens, 9 inches long.

Mugil Joyneri, sp. n.

D. 4 | $\frac{1}{9}$. A. $\frac{3}{8}$. L. lat. 40. L. transv. 14.

The height of the body is less than the length of the head, which is two ninths of the total (without caudal) ; eye small : its diameter is one seventh, the width of the interorbital space more than one third of the length of the head. Adipose eyelid none ; præorbital emarginate and denticulated ; snout longer than the orbit ; extremity of the maxillary visible. There are eighteen scales between the snout and the origin of the spinous dorsal ; no elongate scale in the axil. Dorsal fins equal in height ; the spines are rather slender, the length of the first being rather more than three fourths of the postorbital part of the head ; it is much nearer to the end of the snout than to the base of the caudal fin. The first two rays of the soft dorsal are scaly, the rest of the fin being devoid of scales ; anal scaly anteriorly, as high as the soft dorsal, and commencing in advance of that fin. Caudal notched, one seventh of the total length. Pectoral two thirds of the length of the head. Axil without spot.

Two specimens, 12 inches long.

Cynoglossus Joyneri, sp. n.

D. 106-107. A. 79. L. lat. 85.

Three lateral lines on the left side ; on the level of the end of the abdominal cavity the upper and lower lines are separated from the middle by thirteen rows of scales ; four series of scales between the dorsal fin and the upper lateral line, and four between the anal and lower lateral line. No lateral line on the right side. All the scales on the left side strongly

ctenoid; those of the blind side are nearly smooth on the anterior half of the body, and more conspicuously serrate on the posterior. One nostril situated between the eyes, the other above the lip. Eyes very small, the upper slightly in advance of the lower; interorbital space equal to the width of the orbit. Snout contained twice and two thirds in the length of the head. Angle of the mouth much nearer to the end of the snout than to the hind margin of the gill-cover behind the eye. Tail not much elongate. The height of the body is two sevenths of the total length (without caudal), the length of the head two elevenths. Brownish, mottled with darker.

Two specimens, $9\frac{3}{4}$ inches long.

Harpodon microchir, sp. n.

D. 14. A. 14. V. 9.

This gigantic species of *Harpodon* differs from *H. nehereus* in having a second distinct band of palatine teeth within the first one, and in having the pectoral fin very short. The tubes of the lateral line are narrow and elongate; the basal half of the adipose fin is covered with scales. The interior of the mouth and gill-cavity is black.

A single specimen, 27 inches long.

BIBLIOGRAPHICAL NOTICE.

Thesaurus Devonico-Carboniferus: the Flora and Fauna of the Devonian and Carboniferous Periods. By J. J. BIGSBY, M.D., F.R.S., &c. 4to. 447 pages. Van Voorst: London, 1878.

NINE years ago we had the pleasure of announcing the completion of Dr. Bigsby's '*Thesaurus Siluricus*'*, a work of long labour and sound knowledge and of great value to the geological world. This respected and veteran geologist has now accumulated a still more ample systematic treasury of fossil genera and species, namely those of both the Devonian and the Carboniferous systems of strata in all parts of the world. He has arranged them, like those of his Silurian '*Thesaurus*,' in a tabular form, showing the authorities and references for the names, and the horizons, recurrences, and localities of the fossils. He takes pleasure in mentioning that the publication of both of these great works has been aided by grants from the Royal Society.

The organic remains of the DEVONIAN rocks, arranged in natural classification, occupy an elaborate table of 106 pages. Their localities

* Ann. & Mag. Nat. Hist. ser. 4, vol. iii. (1869) p. 314.

in America are enumerated in 2 pages; those in other regions in 5 pages. At page 17 and afterwards the American species are marked with an *accent*. The lithological and natural-history characters of the Devonian horizons, groups, or stages in different parts of the world are concisely and clearly shown in pages 114-126; and the books and authors quoted are enumerated at pages 127-135.

The CARBONIFEROUS flora and fauna, arranged (1) separately for North America on one page and for Europe on the opposite, order by order, in one Table, and (2) in a supplemental Table, similarly, for other parts of America on one hand, and for previously unmentioned regions on the other, take up pages 137-411. Two sets of *Addenda* of species and genera received by the author whilst the foregoing Tables were at press, and arranged like them, occupy 23 (414-426 *j*) pages.

Short summaries of the Carboniferous stratal groups (1st, in America; 2nd, in Europe, Asiatic Russia, Bear Island and Spitzbergen, the Punjaub, and Queensland) are given in 4 pages; and the authors quoted, in pp. 431-440.

A most valuable Table, giving an Analytical Conspectus of the Devonico-Carboniferous Flora and Fauna, faces page 441; and this is supplemented at page 444 with the results of the Devonian Addendum and of the Carboniferous Addenda; so that at p. 445 we find the numerical result of this conscientious and most laborious examination of the whole literature of this extensive subject. Of the whole of the Devonian and Carboniferous species known up to the date of publication, in "America" and "Europe" (that is, *Europe and the other regions* associated with it in the other lists), we see:—

Devonian Species.		Carboniferous Species.		
Common to America and Europe, &c.	Total known.	Common to America and Europe, &c.	Doubtful.	Total known.
86	4830	239	73	9171

The number of species common to these two great distinct, though allied, systems is inadvertently omitted, although the subject is entered in the Table of Contents at p. 447.

We have, however, been enabled to draw certain conclusions, which, though imperfect, are not without their use; and they will be followed up, we believe, by our indefatigable author in a forthcoming commentary on the percentage of recurrent species and other matters of interest. The total number of both Devonian and Carboniferous *species* is 14,000, divisible into about 1140 *genera*. Of these latter there are:—

In America.		In Europe, &c.		
About 12 per cent.		17 per cent.		in the Devonian only.
" 11 "		16 "		in the Devonian and Carboniferous.
" 18 "		27 "		in the Carboniferous only.

About 21 per cent. of the genera are common to the two hemispheres.

Many philosophic deductions are drawn by Dr. Bigsby from the results of his long-continued study. He notes the fewness of *species*, whether Devonian or Carboniferous, common to the two Hemispheres—in accordance, he observes, with the more or less distinct areas of deposits, possibly, in some degree, homotaxeous rather than contemporaneous. He finds, as is usually the case, that the species of the lowest organic rank are the most frequently found in widely separate countries, as Plantæ (1 in 15), Amorphozoa (1 in 8 or 10), Foraminifera (1 in 7); while the higher orders, Reptilia, Pisces, Insecta, Crinoidea, Mollusca, &c., rarely remove from their native regions, east or west. Numerous suggestive statements as to the conditions and extent of stratal groups, *constant* or *non-constant*, the mutual relations of species, their occurrence, distribution, persistency, migration, recurrence, and their natural-history standing, are given in the Introduction, pp. v-x.

In contemplating this single portion, one trace, as it were, of an exhaustless treasury of proof upon proof of Omnipotent Design, the author agrees with Hunter and Owen that "the creative force has not deserted the earth during any of the epochs of geological time that have succeeded to the first manifestation of such force, and that in respect to no one class of animals has the operation of that force been limited to one geological epoch. Perhaps the most important result of palæontological research has been the establishment of the axiom of the continuous operation of the ordained incoming of new species of living things" ('Hunter's Essays and Observations,' arranged by R. Owen, F.R.S.).

The ever-active influence of the great Presiding Mind thus consummates the Creator's great Design through the Past and the Future, which is to Him To-day; and, adds the author, "so vast and ever active is the power of conditions (that is, of the many surrounding agencies, of long periods of time, and of original impress from without), that I am well satisfied to expect from them the organic changes we observe, and without seeking further."

A well-founded hope is expressed in the Introduction that "this work will assist in opening out a new field of inquiry into what may be called 'Comparative Palæontology'"—that is, comparison of the life and conditions of geological horizons, far apart in succession, whether of wide extent or divided among limited areas.

These labours of Dr. Bigsby among the Silurian, Devonian, and Carboniferous Fossils certainly widen most extensively that field of research already commenced by Bronn (in his 'Lethæa Geognostica') and others, and enable the several students of different groups of fossils and their strata both to begin and to proceed with their work far more satisfactorily, and with far less liability to error, than heretofore. All that has been done in these several palæontological walks is elaborately catalogued and clearly expressed by our author; and the mistakes of naturalists, word-makers, copyists, and

compilers will be readily met with and corrected under the earnest eye of the competent student, who will be too thankful for the aid given him in cultivating his special field to find fault with the few weeds and stones left on its ready-prepared surface.

MISCELLANEOUS.

On the Origin and Distribution of the Turbellaria of the deep Fauna of the Lake of Geneva. By M. DUPLESSIS.

It appears from the author's researches that all the species of Turbellaria from the bottom of the Lake of Geneva are also found (with the exception of two very remarkable species, which are at the same time the types of new genera) either in the stagnant waters of the shores, or in those of the marshes or small lakes of other parts of the canton. Nevertheless two reservations must be made in this respect: the first is, that many species which are met with in the stagnant waters of the country are not to be found in the mud of the deep waters; the second is, that the greater number of species which live also at a great depth have undergone some easily appreciable modifications.

Speaking first of the Dendrocœlous Turbellaria or Planarians, the author describes the modifications which are observed in *Dendrocœlum lacteum* and *fuscum* on comparing the individuals of the shores with those which inhabit the depths of the lake. The specimens coming from great depths are generally smaller and lighter in colour, and are further distinguished by the rosy colour of the digestive tube. The visual organ tends to become atrophied; one of these varieties of *D. lacteum* is remarkable for the division of each oculiform point into two smaller parts, and has been described by M. Gräff under the name of *Planaria quadrioculata*.

Other species, such as *Planaria gonocéphala*, so common in the rivulets of the Jorat, never descend so far as the lake; and it is the same with the numerous representatives of the genus *Polycelis*.

Usually the *Planariæ* of the deep fauna appear to have emigrated from the waters of the shores; but this group is represented at the bottom of the lake by a smaller number of species.

Some very similar facts strike us in the distribution of the Rhabdocœla. *Typhloplana viridis* and *T. subfusca*, which occur everywhere in the stagnant waters of the country, are also met with in the depths of the Lake of Geneva, while *T. pellucida* and *T. pallida*, so common in the pools, have not yet been seen in the mud of the lake.

Regarding the Vorticinæ, *Mesostomum Ehrenbergii*, *lingua*, and *pusillum* are found both in the shallows and depths of the lake, while *M. personatum* appears, on the contrary, to be absent in the latter.

A curious type, *Microstomum lineare*, which is met with everywhere on the shores, descends also to the deep waters of the lake; but it there invariably becomes larger, and its intestine of a pale rose-colour similar to that of the *Planariæ*.

Lastly the Rhynchocoëles or Nemertians are represented in the deep fauna by *Prostomum lineare* and *Prorhynchus stagnalis*, which are also found, the former in the pools of the shore, the latter in springs and under the stones of rivulets.

These observations are sufficient to show that the deep fauna of the Lake of Geneva has originated, at least as regards the Turbellaria, from the littoral and paludicolous species of the neighbouring regions. Yet (and this is the most remarkable point in this investigation) two species of the deep fauna completely evade this interpretation, owing to the fact that they are not found in the waters of the shores, and that, on the contrary, they resemble Mediterranean types. These two species have been provisionally described under the names of *Vortex lemani* and *Mesostomum morgiense*, and probably belong to new genera. The latter, in particular, is certainly not a true *Mesostomum*, but belongs to a family of Turbellaria hitherto exclusively marine. These two forms, without analogues in the remainder of our fauna, are at the same time those which reach the greatest depth. They have only been found in a few other European lakes—as, for instance, in that of Starnberg, in Bavaria.

The class Turbellaria is not, however, the only one which presents facts of this kind. M. Vernet has found amongst the crustaceans of the deep fauna a form related to the genus *Cythere*, which is, as is well known, exclusively marine. M. Duplessis has himself remarked amongst the Arachnida of the lake two species which bear a striking resemblance to marine types. One is the *Campognatha Forelli*, which so exactly resembles a small *Campognatha* of the Mediterranean shores, that at the first glance one might confound the two species. The other belongs to a singular genus, which also occurs in the mud of the Mediterranean. How can facts of this nature be explained? Perhaps we have here the last remains of a marine population, some types of which have accommodated themselves to fresh water as the sea retreated. This, however, is a mere conjecture; and we all know how circumspectly we must venture upon this ground.—*Bibl. Univ.* Oct. 15, 1877, *Arch. des Sciences*, p. 326.

Characters of a new Species of Dryops from Formosa (Coleoptera, Parnidæ). By CHARLES O. WATERHOUSE.

The British Museum has recently received a small collection of objects of natural history from the island of Formosa. They were presented by Mr. Matthew Dickson; and among the Coleoptera I find a specimen of the genus *Dryops* which belongs undoubtedly to an undescribed species. I propose to name it

Dryops Dicksoni.

D. elongatus, griseo-flavescens, sericeus; thorace parum convexo, disco medio leviter impresso, angulis posticis divergentibus, acutissimis; elytris striatis.

Long. 4 lin.

Very closely allied to *D. substriatus*; but, besides being nearly double the size, it differs in having the thorax less convex, with a slight impression on the disk, the sides are less arcuate and more distinctly margined, and the posterior angles are much more diverging. The elytra are more distinctly broader than the thorax, more evidently striated; and, lastly, the pubescence on the head and thorax is more erect and darker in colour.

Hab. Formosa.

British Museum,
May 15, 1878.

On the Organ called "Dorsal Chord" in Amphioxus lanceolatus.

By MM. J. RENAUT and G. DUCHAMP.

In the Vertebrata the tissues of the skeleton may be divided into three principal categories:—1, the primary axis, formed by the dorsal chord; 2, the cartilaginous tissue; 3, the osseous tissue. These different tissues succeed one another in the higher animals, and the definitive skeleton is formed by bone, or at least by true or calcified cartilage. At this period there only remain rare vestiges of the primary axis or dorsal chord; so that, except *Amphioxus*, we know of no Vertebrate of which the definitive skeleton is represented solely by a persistent notochord.

This organ, moreover, possesses in the series typical characters which it is necessary to refer to briefly; it is formed of globular cells, soldered to one another after the fashion of epithelia, as transparent as glass, and possessing a very distinct nucleus (usually thrown back to the periphery).

The dorsal chord of fishes does not differ fundamentally from that of the embryos of the highest Mammalia. That of *Amphioxus*, on the contrary, presents no arrangement resembling the structure just described. It is contained in a cylindrical sheath which envelops it on all sides; and, in sections made perpendicularly to the general axis of the body, after hardening in dextrine and alcohol, it proves to be constituted as follows:—

In the interior of the sheath, stretched horizontally from the left to the right side, are seen some fibres of uniform diameter, cylindrical, solid, and adhering by their extremities to the general envelope. In proportion as they approach the dorsal surface these fibres curve gently upwards, so as to circumscribe in the median line, between the sheath and the chord, an empty spindle-shaped space. On the ventral side the same arrangement is repeated in the opposite direction; so that only the fibres of the middle plane are horizontal and rectilinear.

In a longitudinal section passing through the axis of the chord and the two sides of the body the sheath is shown divided in the direction of its length; and the area thus intercepted is occupied by the fibres of the chord, which consequently offer a scalariform arrangement relatively to the two margins of the sheath.

In such a preparation, suitably coloured by means of picrocarmine of ammonia or of eosine dissolved in water, we observe the following details:—

The sheath of the notochord becomes uniformly coloured red by the carmine, without showing any nucleus either in its interior or at its outer surface; the eosine leaves it absolutely colourless. All the inner surface bristles with a multitude of little conical projections, which are continuous at their base with the hyaline substance of which the envelope is formed. These little cones remain colourless with carmine, and acquire a bright rose-colour with eosine; they do not present the appearance of nuclei, and are entirely homogeneous. At the extremity of each of them is inserted, at the same time capping it, one of the fibres of the notochord. Each fibre answers by each of its extremities to one of the projections just described; it is regularly cylindrical, contains no nucleus, and becomes coloured, like elastic tissue, yellow by the action of the picrocarminate, and bright rose by eosine.

The action of potash does not cause the breaking-up of these fibres into nucleated masses; carmine, hæmatoxyline, and the other reagents for nuclei do not reveal any in the thickness of the sheath. We are therefore justified in regarding them as non-cellular bodies, having no relation either with the characteristic tissue of the notochord or with cartilage. On the other hand they present a structure and histochemical reactions exactly analogous to those offered by the fibres which compose the axial organ of the Calamary known as the *pen*.

From what precedes, it appears that the *Amphioxus*, which is destitute of red blood containing hæmoglobine enclosed in special elements, also does not possess a dorsal chord comparable by its structure to that of all vertebrate animals. It therefore seems permissible to raise doubts as to the morphological value of its notochordal axis.—*Comptes Rendus*, April 8, 1878, p. 898.

On the Zoological Affinities of the Genus Mesites.

By M. A. MILNE-EDWARDS.

In 1838, I. Geoffroy Saint-Hilaire described a very remarkable bird from Madagascar under the name of *Mesites variegatus*. From its external characters he had great difficulty in referring it to any definite place in the system; and he remarked that it resembled the *Heliornithes* in its head, the Penelopes and Curassows in its body, and especially its wings, and the Pigeons in its feet. Some years later M. Desmurs described a somewhat different bird under the name of *Mesites unicolor* as a new species. G. R. Gray, in his 'Genera of Birds,' arranged *Mesites* in the family Megapodiidæ, close to *Leipoa*; and in this he was followed by Bonaparte, Reichenbach, and Hartlaub; but in the British-Museum Catalogue of Birds, Gray shifted the genus to the Passeres, as forming a section of the family Eupetidæ. Sundevall accepted this view; and Hartlaub, in his last work on the birds of Madagascar, placed *Mesites* after the Motacillidæ, among the Dentirotres.

All this time the only known specimens were the two originally described respectively by Geoffroy Saint-Hilaire and Desmurs; but M. A. Grandidier has recently received from Tamatava two

Mesitæ, preserved in spirits, which he has sent to M. Milne-Edwards for examination. The results of this investigation are given by the author as follows:—

“The *Mesitæ*,” he says, “are neither Gallinaceæ nor Pigeons, as I. Geoffroy and Prince Charles Bonaparte thought; nor are they Passeres, as Gray, Sundevall, and Hartlaub supposed. They must occupy a place among the Grallæ, in which they form a family allied to the Rails and Herons. I cannot now dwell upon the conformation of the different parts of the skeleton and muscular system; these details will be set forth in a special memoir; and I shall confine myself here to noting that the sterno-clavicular apparatus is remarkable, and indicates only a very feeble power of flight; its characters are quite peculiar, although reminding one a little of those of certain Rails. The keel is not very prominent, and its anterior angle is carried back nearly to the middle of the sternum; the lateral plates are much reduced and cut into on each side by a deep emargination of the posterior margin. The episternal apophysis, which is very strong, very long, and carinate below, bifurcates at its apex to furnish points of attachment for the ligaments of the shoulder. *There is no trace of a furcular bone*; there is not even an osseous style like that which exists in certain nocturnal Rapacious birds, in some Parrots, and several Pigeons. The wings, which are very short, cannot enable the *Mesitæ* to sustain themselves long in the air.

“The pelvis is as remarkably broad as the sternum is narrow; we remark in it some of the characters proper to the *Eurypygæ* and Rallidæ. The feet are strong, and the toes, like those of the Blongios (*Ardea minuta*) and some other Herons, are constructed so as to be able to grasp reeds and vertical stems.

“The muscles greatly resemble those of the Rallidæ. As in the latter, we find a femoro-caudal and its accessory, a semitendinosus and its accessory, and an iliac accessory of the perforate flexor of the toes, which, starting from the ilio-pectineal apophysis, passes along the inside of the thigh and over the rotula, and is inserted upon the superficial flexor of the toes; this latter bundle is deficient in the Ardeidæ and in the Passeres. There are two carotids, as in the Rails and Herons, whilst the Passeres only possess a left carotid.

“The *Mesitæ* are also remarkable for the existence of five pairs of down-patches hidden beneath the feathers, and occupying on the dorsal surface of the body the scapular and iliac regions, and on the ventral surface the pectoral, costal, and abdominal regions. The Herons present patches of the same nature, but differently disposed. The attention of naturalists had already been called to these peculiarities by Mr. E. Bartlett.

“Lastly, I may add that the differences of form and coloration which appeared to M. Desmurs sufficient to distinguish *Mesites unicolor* from *M. variegatus* appear to me to be due to sex; in fact the female *Mesites* that we possess is exactly like *M. unicolor*, and the male has all the characters of that described by I. Geoffroy under the name of *variegatus*.”—*Comptes Rendus*, April 22, 1878, p. 1029.

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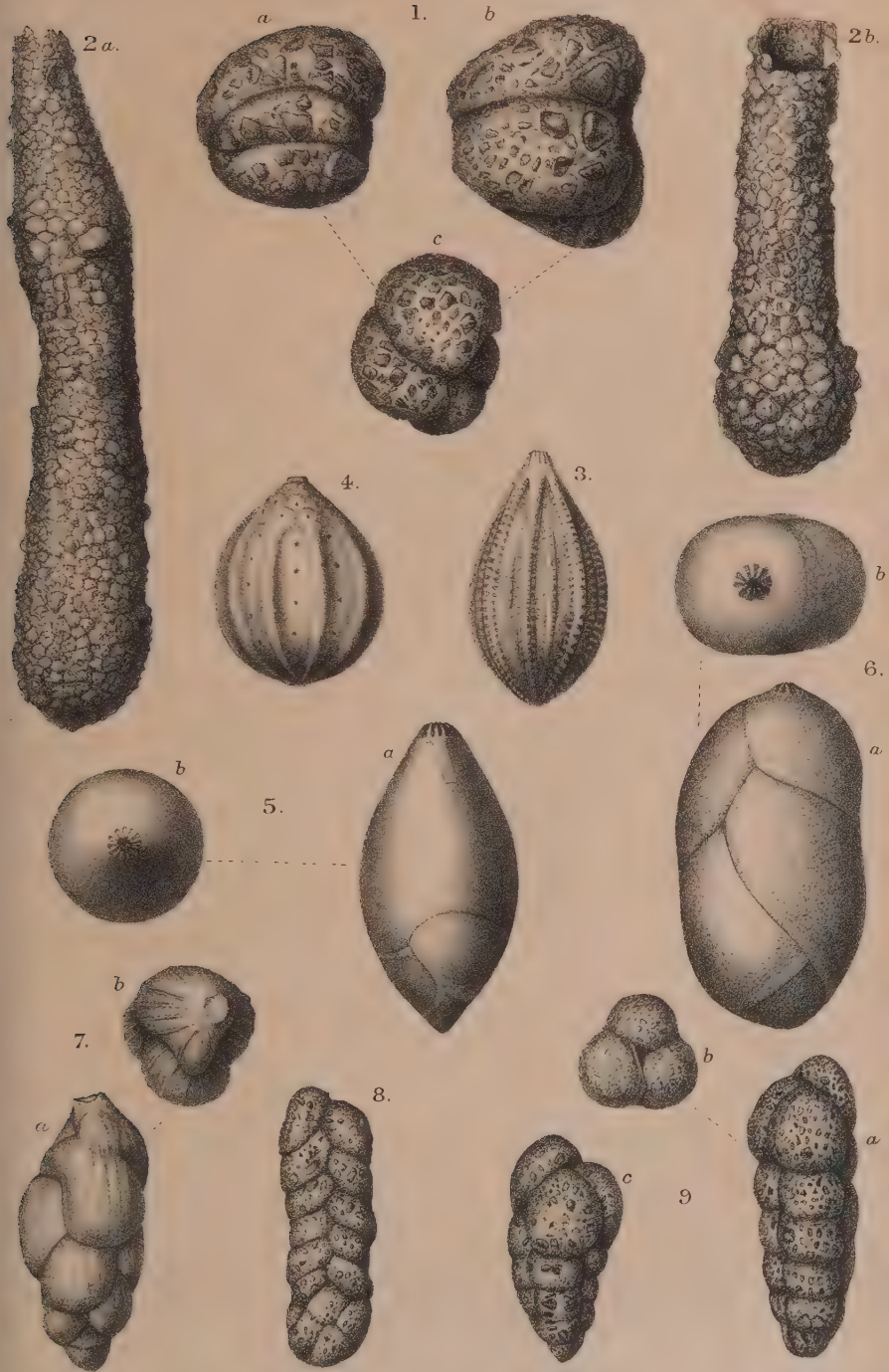
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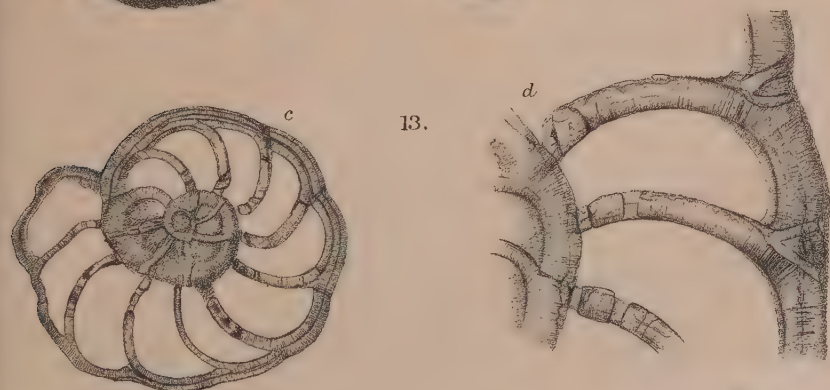
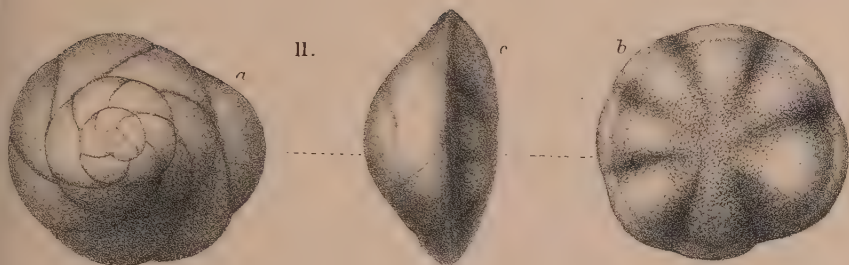
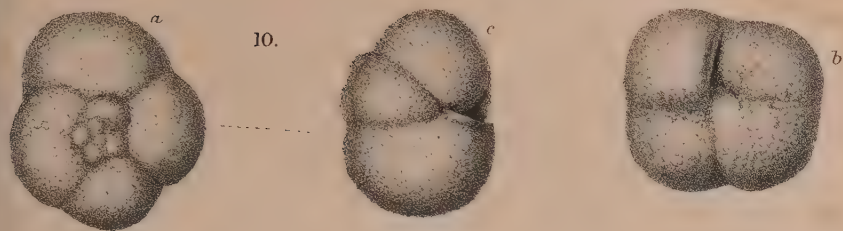


PLATE I.

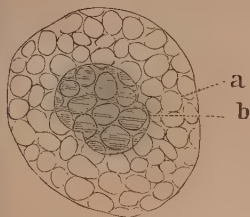


FIG. 1

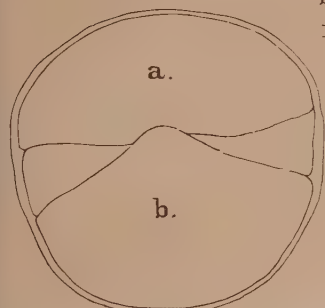


FIG. 3.

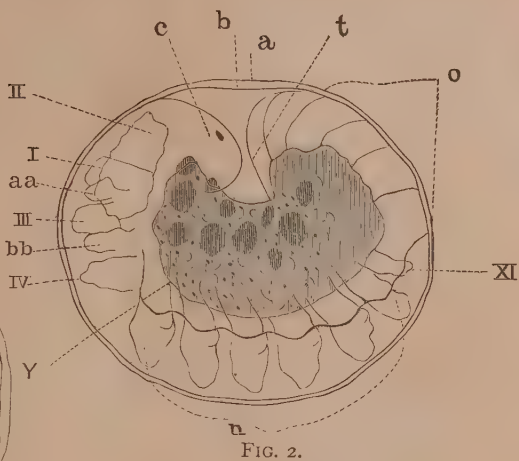


FIG. 2.



FIG. 4.



FIG. 4 a.



FIG. 4 b.



FIG. 4 d.

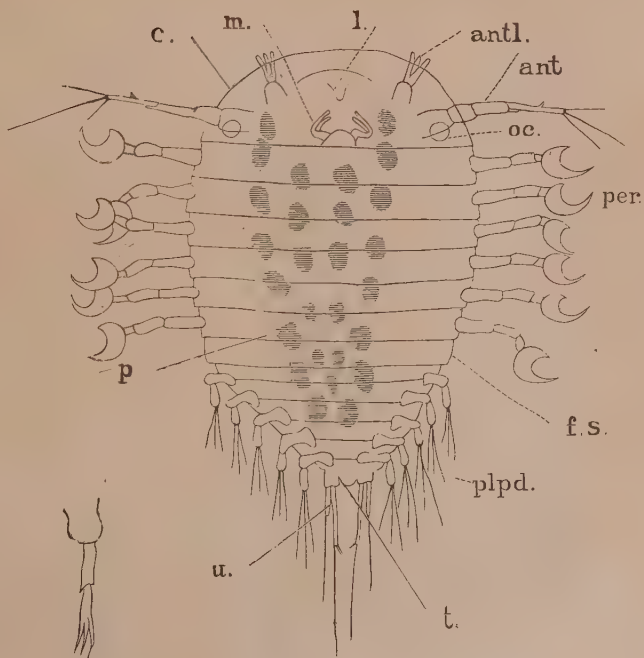


FIG. 4 c.

FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.

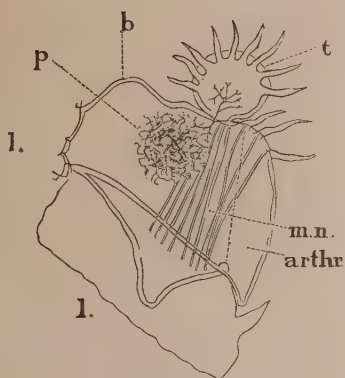


FIG. 9.

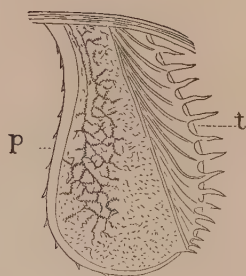


FIG. 10.



FIG. 11.

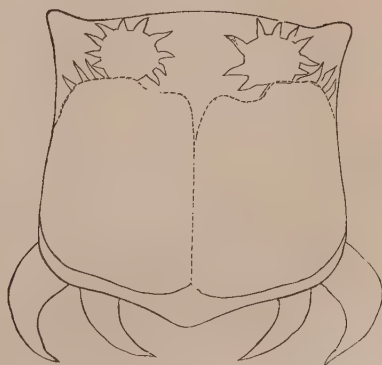


FIG. 12.

NOTES ON NEW ENGLAND ISOPODA.

By OSCAR HARGER.

The marine Isopoda collected by the United States Commission of Fish and Fisheries having been placed in my hands by Professor Verrill, a report has been prepared including full descriptions, with figures of most of the species, except the *Bopyridæ*. Besides the collections of the Fish Commission, I have, through the kindness of Professor Verrill, had access to other extensive collections made principally by himself and Prof. S. I. Smith, at various points along the coast from Great Egg Harbor, New Jersey, to the Bay of Fundy, as is more fully detailed in the report now ready for publication. On account of unexpected delay in the publication of the report, it has been thought best to prepare the following brief summary of its contents, with especial reference to facts not hitherto published. Only such references are here given as are necessary to the understanding of the names adopted, and, in general, the distribution on the New England coast only is indicated.

The *Bopyridæ* have been identified by Professor S. I. Smith, who has also rendered other important assistance in the preparation of the report, of which the present paper may be regarded as an abstract.

The *Oniscidæ*, not being properly marine, are in general not included in the report; but three species, two of them as yet found only on the coast, are included as being commonly found by marine collectors. They are the first three of the following list, which embraces also all the marine Isopoda known to inhabit the waters of New England:

Philoscia vittata Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 429, 1818.

A southern species found as far north as Barnstable, Mass.

Scoyphacella arenicola Smith, Rep. U. S. Fish Com., part i, p. 568 (274), 1874.

Sandy beaches, from Great Egg Harbor, New Jersey, to Nantucket, Mass. Not yet found north of Cape Cod.

Actoniscus ellipticus Harger, Am. Jour. Sci., III, vol. xv, p. 373, 1878.

Shores of Long Island Sound at Savin Rock, and Stony Creek, near New Haven. Collected by Professor Verrill.

Cepon distortus Leidy, Jour. Acad. Nat. Sci. Phil., II, vol. iii, p. 150, pl. xi, figs. 26-32, 1855.

"Branchial cavity of *Gelasimus pugilator*, Atlantic City, New Jersey."

Gyge Hippolytes Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 230, 1868.—*Bopyrus Hippolytes* Kröyer, Grönlands Amphipoder, p. 306, pl. iv, fig. 22, "1838."

Parasitic on *Hippolyte*, etc., and found as far south as Massachusetts Bay.

Phryxus abdominalis Lilljeborg, Öfversigt af Kongl. Vetenskaps Akademiens Förh. Stockholm, 1852, p. 11.—*Bopyrus abdominalis* Kröyer, Naturhist. Tidssk., Bind iii, p. 102, 289, pl. 1, 2, (1840); Gaimard's Voyage en Scandinavie, etc., Atlas, pl. xxix, fig. 1 a-u, "1849."

Parasitic on *Pandalus*, *Hippolyte*, etc., and found as far south as Massachusetts Bay.

Dajus mysidis Kröyer, Gaimard's Voyage en Scandinavie, etc., Atlas, pl. xxviii, fig. 1, "1849."—*Bopyrus mysidum* Packard, Mem. Soc. Nat. Hist. Boston, vol. 1, p. 295, pl. viii, fig. 5, 1867.

Parasitic on *Mysis*, but not hitherto found south of Labrador.

Jæra albifrons Leach, Edinburgh Encyclopædia, vol. vii, p. 434, "1813-14"; Trans. Linn. Soc. London, vol. xi, p. 373, 1815.—*Jæra copiosa* Stimpson, Mar. Invert. Grand Manan, p. 40, pl. iii, fig. 29, 1853.

Common throughout the New England coast under sea-weed, in tide pools, etc. A comparison of specimens received from Oban, Scotland, through the kindness of Rev. A. M. Norman, indicates that our species must be regarded as identical with the well-known British species, and is therefore common to the two coasts.

Janira alta = *Asellodes alta* Stimpson, Mar. Invert. Grand Manan, p. 41, pl. iii, fig. 30, 1853.

A northern species not as yet found south of Massachusetts Bay, occasionally collected in tide-pools, but usually dredged, and extending to a depth of 190 fathoms.

This species is easily distinguished specifically from *J. maculosa* Leach, the type of the genus, but does not appear to differ by characters of generic importance, and I have therefore referred it to the older genus.

Janira spinosa, n. sp.

A second species of this genus was obtained in the summer of 1878, and on examination it appears to be as yet undescribed, although somewhat resembling *J. laciniata* G. O. Sars, but distinguished by the double instead of single row of spines along the dorsal region of the thorax.

The head is strongly rostrate, and has the antero-lateral angles acutely produced, but shorter than the median rostrum. The eyes are small and black, and placed a little behind the middle of the head, at about an equal distance from the median line and the lateral margin. The antennulæ are slender, and slightly surpass the first four segments of the antennæ. The antennæ are about as long as the head and thorax together, and the scale attached to the second peduncular segment is slender and pointed, surpassing the third segment. The flagellum forms about half the length of the antenna, and is slender, tapering, and multi-articulate.

The thoracic segments are all acutely produced at the sides into one or two salient angles, forming a row of acute serrations along the sides of the body. The first segment has a single angle produced somewhat

forward around the sides of the head; the second, third, and fourth segments usually present two serrations, both the anterior and posterior angles being produced and acute, and the last three segments are produced and directed more and more backward. In the dorsal region, each segment bears a pair of sharp tubercles or spines. Anteriorly these spines are near the front margins of the segments and directed forward, but become posteriorly more erect and nearer the middle of the segment, and the last three pairs are directed backward, the last pair being near the hinder margin of the seventh segment. The legs are slightly spiny, the first pair but little thickened in the females. The pleon tapers at the sides, where it is minutely serrulate. Its posterior angles are salient and acute, like the anterior angles of the head. The uropods are of moderate length, about as long as the pleon, and composed of a cylindrical basal segment, bearing two rami, of which the inner is somewhat the larger, and nearly as long as the basal segment. Both, together with the basal segment, are sparingly bristly.

The color in alcohol is nearly white. Length 8^{mm}.

Two specimens of this species were collected at Banquereau by Captain Collins, of the schooner Marion, August 25, 1878. They were found adhering to the cable of the schooner.

Munna Fabricii Kröyer, Naturhist. Tidssk., II, Bind ii, p. 380, 1847; Gaimard's Voyage en Scandinavie, etc., Atlas, pl. 31, figs. 1 *a-q*, 1849.

Casco Bay, near Portland, Me., Eastport and Western Bank, from low water to 150 fathoms.

Munnopsis typica M. Sars, Christiania Vidensk. Selsk., 1860, p. 84, 1861; Bidrag til Kundskab om Christiania Fjordens Fauna (Nyt Magazin), p. 70, pl. vi, vii, figs. 101-138, 1868.

This species has been taken in the Bay of Fundy in 60 fathoms; also, by Mr. J. F. Whiteaves, in the Gulf of Saint Lawrence.

Eurycope robusta Harger, Am. Jour. Sci., III, vol. xv, p. 375, 1878.

Not yet found south of the Gulf of Saint Lawrence, where it was taken by Mr. J. F. Whiteaves in 220 fathoms, muddy bottom.

Chiridotea cæca Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.—*Idotea cæca* Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 424, 1818.

Common on the southern coast of New England, and taken as far north as Halifax in the summer of 1877.

Chiridotea Tuftsii Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.—*Idotea Tuftsii* Stimpson, Mar. Invert. Grand Manan, p. 39, 1853.

This species has been taken at various points along the coast from Long Island Sound to Halifax, but was regarded as rare until the summer of 1878, when it was collected in abundance at Gloucester, Mass.

Idotea irrorata Edwards, Hist. nat. des Crust., tome iii, p. 132, 1840.—*Stenosoma irrorata* Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 423, 1818.—*Idotea tricuspidata* Desmarest, Dict. des Sci. nat., tome xxviii, p. 373, 1823; Consid. Crust., p. 289, 1825.

This species is common throughout the coast of New England, but is more abundant southward, being to a great extent replaced toward the north by the next species.

A comparison of English and European specimens with our own leaves no doubt of the identity of the species on the opposite coasts of the Atlantic. Being a common European species, it has been mentioned by many authors under a variety of names, which are more fully quoted and discussed in the report. Say's name appears to be the earliest that can be certainly connected with the species.

Idotea phosphorea Harger, Rep. U. S. Fish Com., part i, p. 569 (275), 1874.

Found throughout the coast, but more abundant northward.

Idotea robusta Kröyer, Naturhist. Tidssk., II, Bind ii, p. 108, 1846; Gaimard's Voyage en Scandinavie, etc., Atlas, pl. xxvi, fig. 3 a-r, 1849.

A pelagic species.

Synidotea nodulosa Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.—*Idothea nodulosa* Kröyer, Naturhist. Tidssk., II, Bind ii, p. 100, 1846; Gaimard's Voyage en Scandinavie, etc., Atlas, pl. xxvi, fig. 2, 1849.

A northern species, found at Halifax, N. S., and 125 miles southward, in from 16 to 190 fathoms. Also from George's Bank.

Synidotea bicuspidata = *Idotea bicuspidata* Owen, Voyage of the Blossom, Crustacea, p. 92, pl. xxvii, fig. 6, 1839.—*Idotea marmorata* Packard, Mem. Soc. Nat. Hist. Boston, vol. i, p. 296, pl. viii, fig. 6, 1867.—*Idotea pulchra* Lockington, Proc. Cal. Acad. Sci., vol. vii, p. 45, 1877.

The determination of the synonymy of this species rests principally upon the work of Messrs. Streets and Kingsley in the Bulletin of the Essex Institute, vol. ix, p. 108, 1877. It has not yet been found south of the Grand Bank.

Erichsonia filiformis Harger, Rep. U. S. Fish Com., part i, p. 570 (276), pl. vi, fig. 26, 1874.—*Stenosoma filiformis* Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 424, 1818.

A southern species, not yet found north of Cape Cod.

Erichsonia attenuata Harger, Rep. U. S. Fish Com., part i, p. 570 (276), pl. vi, fig. 27, 1874.

Great Egg Harbor, New Jersey, and Noank, Conn. The species will probably be found at other localities, among eel-grass, on the southern shore of New England.

Epelys trilobus Smith, Rep. U. S. Fish Com., part i, p. 571 (277), pl. vi, fig. 28, 1874.—*Idotea triloba* Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 425, 1818.

A southern species, rare north of Cape Cod, but extending, with some other southern species, to Quahog Bay, on the coast of Maine.

Epelys montosus Harger, Rep. U. S. Fish Com., part i, p. 571 (277), 1874.—*Idotea montosa* Stimpson, Mar. Invert. Grand Manan, p. 40, 1853.

Replaces the preceding species for the most part at the north, but found also as far south as Long Island Sound. It has been obtained from a depth of 40 fathoms.

Astacilla granulata = *Leachia granulata* G. O. Sars, Arch. Math. og Naturvid. Christiania, B. ii, p. 351 (proper paging 251), 1877.—*Astacilla Americana* Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.

St. George's Banks, 1877, and Banquereau, 1878. I have seen no specimens of Sars's species for comparison, but his description appears to apply perfectly to the specimens described by myself before seeing his paper.

Sphæroma quadridentatum Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 400, 1818.

A southern species, scarcely passing north of Cape Cod, but occurring at Provincetown, Mass.

Limnoria lignorum White, Pop. Hist. Brit. Crust., p. 227, 1857.—“*Cymothoa lignorum* Rathke, Skrivt. af Naturh. Selsk. v. 101, t. 3, f. 14, 1799.”—*Limnoria terebrans* Leach, Edinburgh Encyc., vol. vii, p. “433, 1813-14”; Trans. Linn. Soc. London, vol. xi, p. 371, 1815.

This genus was associated with the *Asellidæ* by Edwards without an examination of the specimens, and, so far as I know, he has been followed by recent authors. An examination of its structure appears to point unmistakably to affinity with the *Sphæromidæ*. I have not, however, thought best to include it in that family, but have placed it in a family by itself, the *Limnoriidæ*.

The species extends throughout the New England coast.

Cirolana concharum = *Conilera concharum* Harger, Rep. U. S. Fish Com., part i, p. 572 (278), 1874.—*Ega concharum* Stimpson, Mar. Invert. Grand Manan, p. 42, 1853.

Not found north of Cape Cod, but abundant at Vineyard Sound.

Cirolana polita = *Conilera polita* Harger, in Smith and Harger, Trans. Conn. Acad., vol. iii, p. 3, 1874.—*Ega polita* Stimpson, Mar. Invert. Grand Manan, p. 41, 1853.

St. George's Banks, Salem, and Eastport (Stimpson), rare.

Ega psora Krøyer, Grønlands Amfipoder, p. 318, “1838.”—*Oniscus psora* Linné, Syst. Nat., ed. x, tom. i, p. 636, 1758.—*Ega emarginata* Leach, Trans. Linn. Soc. London, vol. xi, p. 370, 1818.

Parasitic on the Cod, Halibut, etc.; also dredged on St. George's Banks.

Nerocila munda Harger, Rep. U. S. Fish Com., part i, p. 571 (277), 1874.

On dorsal fin of *Ceratacanthus aurantiacus*, Vineyard Sound.

Egathoa loliginea Harger, Am. Jour. Sci., III, vol. xv, p. 376, 1878.

Mouth of Squid, New Haven, Conn.

Livoneca ovalis White, List Crust. Brit. Mus., p. 109, 1847.—*Cymothoa ovalis* Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 394, 1818.

White and several other British carapidologists use the orthography *Lironeca*; but in the Dictionnaire des Sciences naturelles, tome xii, where the genus is established by Dr. Leach, the name occurs, in French and Latin, nine times on pages 352 and 353, spelled always with *r* as the third letter. I have, therefore, adhered to that orthography, although there is reason for supposing that Dr. Leach intended to use the form *Lironeca*.

Parasitic on Bluefish, etc.; not yet found north of Cape Cod.

Anthura polita Stimpson, Proc. Acad. Nat. Sci. Phil., vol. vii, p. 393, 1855.—*Anthura brunnea* Harger, Rep. U. S. Fish Com., part i, p. 572 (278), 1874.

A southern species, not found north of Cape Cod until the summer of 1878, when it was taken at Gloucester, Mass. Usually found among Eel-grass or mud in shallow water.

Paranthura brachiata = *Anthura brachiata* Stimpson, Mar. Invert. Grand Manan, p. 43, 1853.

A northern species, but found as far south as Vineyard Sound, from 27 to 115 fathoms.

Ptilanthura tenuis Harger, Am. Jour. Sci., III, vol. xv, p. 377, 1878.

Rare, but found throughout the New England coast. The remarkably elongate flagellum of the antennulae belongs to the males only.

Gnathia cerina = *Praniza cerina* Stimpson, Mar. Invert. Grand Manan, p. 42, pl. iii, fig. 31, 1853; and, also, *Ancus Americanus* Stimpson, op. cit., p. 42, 1853; the former being the female form and the latter that of the adult male.

A northern species, not yet found south of Cape Cod, occurring in from 10 to 220 fathoms, and, in the young stages, parasitic on fish.

Tanais vittatus Lilljeborg, Bidrag til Känn. Crust. Tanaid., p. 29, 1865.—*Crossurus vittatus* Rathke, Fauna Norwegens, (Nova Acta Acad., vol. xx,) p. 39, pl. i, figs. 1-7, 1843.

This species has been found at Noank Harbor, Conn., and will probably be found at other localities on our coast. I have had no European specimens for comparison, and, unfortunately, have not had access to some important European literature on the subject, but do not know of any character by which to distinguish it from Rathke's species, and have therefore regarded it as identical.

This genus is well separated from the next by the pleon, which bears only three pairs of pleopods and uniramous uropods, and by the remarkable incubatory sacs attached to the fifth thoracic segment of the females, and unlike anything else found among the *Isopoda*. They have been described by Rathke, Willemoes-Suhm, and others.

Leptochelia algicola = *Paratanais algicola* Harger, Am. Jour. Sci., III, vol. xv, p. 377, 1878.—*Leptochelia Edwardsii* Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 134, 1868, (males).—*Tanais filum* Harger, Rep. U. S. Fish Com., part i, p. 573 (279), 1874, not of Stimpson.

A male specimen, received from Guernsey, through the kindness of

Rev. A. M. Norman, appears to agree perfectly with the males of this species, though not with Kröyer's description of *Tanaïs Edwardsii*. I have not therefore united my species with his, though I think it possible they may prove identical.

The species occurs in considerable abundance at Noank Harbor, Conn., among algæ, and also at Vineyard Sound, and will probably be found at other localities on the southern shore of New England. It has also been collected by Professor Verrill, during the present summer, at Provincetown, Mass., in company with *Limnoria* and *Chelura*, in old piles.

The genus *Leptochelia* has several years' priority over *Paratanais*, and, though founded on the male sex, ought, as I think, to be retained.

Leptochelia limicola = *Paratanais limicola* Harger, Am. Jour. Sci., III, vol. xv, p. 378, 1878.

Massachusetts Bay, off Salem, 48 fathoms, mud.

Leptochelia rapax, n. s.

Females of this species considerably resemble those of *L. limicola*, but may be distinguished by the following characters: The eyes are larger and more conspicuous; the last segment of the antennulæ is scarcely longer than the preceding, instead of nearly twice as long, as in *L. limicola*; the dactylus of the second pair of legs is somewhat shorter and the terminal spine less attenuated, and the external ramus of the uropods consists of a single very short and small segment, shorter than the basal segment of the inner ramus, which is not elongated. The inner ramus is five-jointed, instead of six-jointed, as in *L. algicola*.

The males are remarkable for the long and slender prehensile hand terminating the first pair of legs. The body of the males is short and robust, with the segments well marked by constrictions. The head, with the united first thoracic segment, is short and rounded, bulging strongly at the sides just behind the eyes, which are conspicuous, somewhat less in diameter than the bases of the antennulæ, distinctly articulated, and coarsely faceted. The antennulæ are elongated, especially in the basal segment, which is more than one-third as long as the body, slightly swollen on the inner side, near the base, then tapering to the tip; the second segment is cylindrical, less than half as long as and more slender than the first; the third is less than half the length of the second, and is followed by about eight short flagellar segments, the last one tipped with setæ. The antennæ, when extended, do not attain the end of the basal antennular segment; the first three segments are short, the fourth longest, being longer than the first three together, the fifth slender and tipped with setæ. The terminal setæ of both antennulæ and antennæ arise in part from minute or rudimentary terminal segments. The first pair of legs forms the most striking feature of this species. These legs, when extended, are in general longer than the body of the animal, though they vary considerably in size, being usually proportionally smaller in the smaller specimens. In these legs, the segments preceding the carpus are short and robust; but the carpus is about half as long as the body, and the propodus

is even somewhat longer than the carpus, and usually strongly flexed beneath it. More than half the length of the propodus is made up of the slender digital process, which bears a low tooth on the inner side, near the base, and a stouter one near the slender incurved tip. The dactylus is slender, curved, and pointed, and armed with a few weak spinules along the inner margin. The forceps thus formed are capable of seizing and closing around the body of another individual.

The thoracic segments, except the first, are well separated; the second (first free) segment is shortest; the third, fourth, and fifth segments are of increasing length; the sixth is as long as the fifth; the seventh shorter. The first five segments of the pleon are of about equal length; the sixth shorter and obtusely pointed in the middle. The uropods consist on each side of a robust basal segment, bearing two rami, the outer short, and composed of a single segment, the inner five-jointed and tapering. Both rami are sparingly bristly. The males vary in length from 2.6^{mm} to 3.8^{mm}, and in breadth from 0.6^{mm} to 0.8^{mm}. The females are more slender. Color in alcohol nearly white or marked in the males by a brownish transverse band along the posterior margin of each segment.

This species was collected by Professor Hyatt and Messrs. Van Vleck and Gardner at Annisquam, Mass., in the summer of 1878.

Leptochelia filum = *Tanais filum* Stimpson, Mar. Invert. Grand Manan, p. 43, 1853.

"Bay of Fundy," Stimpson.

Leptochelia cæca = *Paratanais cæca* Harger, Am. Jour. Sci., III, vol. xv, p. 378, 1878.

Collected along with *L. limicola* in 48 fathoms, mud, Massachusetts Bay, off Salem, 1877.

Of the forty-three species enumerated in the preceding list, the following eighteen have as yet been found only north of Cape Cod:

<i>Gyge Hippolytes</i> Bate and Westwood.	<i>Synidotea bicuspidata</i> Harger.
<i>Phryxus abdominalis</i> Lilljeborg.	<i>Astacilla granulata</i> Harger.
<i>Dajus mysidis</i> Kröyer.	<i>Cirolana polita</i> Harger.
<i>Janira alta</i> Harger.	<i>Æga psora</i> Kröyer.
<i>Janira spinosa</i> Harger.	<i>Gnathia cerina</i> Harger.
<i>Munna Fabricii</i> Kröyer.	<i>Leptochelia limicola</i> Harger.
<i>Munnopsis typica</i> M. Sars.	<i>Leptochelia rapax</i> Harger.
<i>Eurycope robusta</i> Harger.	<i>Leptochelia filum</i> Harger.
<i>Synidotea nodulosa</i> Harger.	<i>Leptochelia cæca</i> Harger.

The following ten have been found only south of Cape Cod:

<i>Scyphacella arenicola</i> Smith.	<i>Cirolana concharum</i> Harger.
<i>Atoniscus ellipticus</i> Harger.	<i>Nerocila munda</i> Harger.
<i>Cepon distortus</i> Leidy.	<i>Ægathoa loliginea</i> Harger.
<i>Erichsonia filiformis</i> Harger.	<i>Livoneca ovalis</i> White.
<i>Erichsonia attenuata</i> Harger.	<i>Tanais vittatus</i> Lilljeborg.

The following fifteen have been found both north and south of Cape Cod:

<i>Philoscia vittata</i> Say.	<i>Epelys montosus</i> Harger.
<i>Jæra albifrons</i> Leach.	<i>Sphæroma quadridentatum</i> Say.
<i>Chiridotea cæca</i> Harger.	<i>Limnoria lignorum</i> White.
<i>Chiridotea Tuftsii</i> Harger.	<i>Anthura polita</i> Stimpson.
<i>Idotea irrorata</i> Edwards.	<i>Paranthura brachiata</i> Harger.
<i>Idotea phosphorea</i> Harger.	<i>Ptilanthura tenuis</i> Harger.
<i>Idotea robusta</i> Kröyer.	<i>Leptochelia algicola</i> Harger.
<i>Epelys trilobus</i> Smith.	

The following eleven species occur also on the coast of Europe:

<i>Gyge Hippolytes</i> Bate and Westwood.	<i>Astacilla granulata</i> Harger.
<i>Phryxus abdominalis</i> Lilljeborg.	<i>Limnoria lignorum</i> White.
<i>Jæra albifrons</i> Leach.	<i>Æga psora</i> Kröyer.
<i>Munna Fabricii</i> Kröyer.	<i>Tanais vittatus</i> Lilljeborg.
<i>Munnopsis typica</i> M. Sars.	<i>Leptochelia algicola</i> Harger.
<i>Idotea irrorata</i> Edwards.	

NOTICE OF RECENT ADDITIONS TO THE MARINE INVERTEBRATA, OF THE NORTHEASTERN COAST OF AMERICA, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES AND CRITICAL REMARKS ON OTHERS.

PART I—ANNELIDA, GEPHYRÆA, NEMERTINA, NEMATODA, POLYZOA, TUNICATA, MOLLUSCA, ANTHOZOA, ECHINODERMATA, PORIFERA.

By A. E. VERRILL.

Among the very extensive collections made during the past eight years by the U. S. Commission of Fish and Fisheries, under the direction of Professor Baird, there are still many species not recorded as American in any of the reports hitherto published; most of these are well-known Arctic or Northern European species, but others are still undescribed. As the final reports on the different groups will require a long time for their completion, owing to the vast number of specimens to be examined from more than a thousand localities, it has been thought desirable to record some of the more important additions to the fauna, without further delay.* More detailed descriptions and numerous figures will be published in the final reports, together with the details of their geographical distribution. All the species included in the following list, unless otherwise stated, have been collected by the U. S. Fish Commission.

*Many species have also been recorded in various articles in the American Journal of Science and Arts, during several years past. See, also, an important paper on the Podophthalmous Crustacea, by Professor S. I. Smith, and one on the Pycnogonida, by E. B. Wilson, in the Trans. Conn. Academy, vol. v, 1879.

ANNELIDA.

Sthenelais gracilis, sp. nov.

A small, slender, delicate species. Scales white, smooth, outer edge with few (12-16) very small, unequal, tapering papillæ, which are not crowded, the longest about as long as the intervening spaces. Head short, broad, the posterior and lateral margins rounded, the front emarginate. Eyes black, conspicuous; the posterior pair on the dorsal surface in advance of the middle of the head; anterior pair nearer together, close to the anterior margin; median antenna long, stout at base, tapering to a slender tip; the palpi have about the same form and length as the median antenna. Dorsal setæ longer than the ventral, extremely slender, tapering gradually toward the very fine tips, and very minutely serrulate. Upper ventral setæ (2-4) simple, very slender, with the shaft smooth, the serrate portion broader, with rather long ascending spinules, the tips tapering to a long fine point; the median setæ, above the acicula, have longer, much stouter, smooth shafts, expanded distally, with the terminal portion long, curved, divided into eight to twelve imperfect joints, tapering to very slender capillary tips, which are mostly acute, sometimes faintly hooked. Below the acicula there are others, similar in structure, but with the shaft not so stout, and with the terminal piece shorter, with fewer joints; the lower portion of the fascicle consists of numerous, much more slender, capillary setæ, with smooth shafts and very long, slender, tapering, terminal pieces, composed of ten to twelve or more imperfect joints.

Harbor of Gloucester, Mass., 7 to 10 fathoms, sand, 1879 (U. S. Fish Commission). Described from alcoholic specimens.

Sthenelais Emertoni, sp. nov.

A small, slender species, with white, translucent scales, their outer edge with very small, nearly equal, slender papillæ, often slightly clavate at tip, and rather near together, their interspaces being mostly less than their length; surface partially covered with minute rounded verrucæ.

Dorsal setæ very slender, capillary, very minutely transversely serrulate. Few (about 4) upper ventral setæ, simple, long, slender, with the terminal portion sharply serrulate, the tips fine and sharp; next to these are some slender compound setæ, the terminal piece slender, straight, of moderate length, acute, with six to eight imperfect joints; the median setæ have much stouter, smooth shafts, expanded distally, and a nearly straight, short, rapidly tapering, sharply pointed, terminal piece, of four to six joints; below these are some with similar though smaller shafts, and a short, stout, terminal piece, hooked at the tip, and with a sharp ascending spine at about the distal third; others of the same size have the terminal piece very acute, with six to eight or more joints; the lowest are very slender, with a longer, very fine, tapering, terminal piece, imperfectly divided into about four to six joints, at each of which there is a projecting acute angle like a tooth; the last of

*(From the American Naturalist, January, 1882.)*A SINGULAR PARASITIC ISOPOD CRUSTACEAN AND SOME OF ITS DEVELOPMENTAL STAGES.¹

BY CARL F. GISSLER, PH.D.

THE material for the present paper² was obtained from the common prawn of our shores,³ *Palæmonetes vulgaris* Stimpson,⁴ about ten per cent. of which I found infested, in June, 1881, with a Bopyrus (*Bopyrus palæmoneticola* Packard⁵), probably the same species which Professor Joseph Leidy mentioned as occurring near Atlantic city, N. J.⁶ The female of our Bopyrus averages in size from 3.50 to 4.50^{mm} in length, and 3 to 4^{mm} in width. Its ventral side is invariably turned toward the carapace of the prawn and its marsupium or breeding cavity is usually filled



FIG. 1.—The common prawn (*Palæmonetes vulgaris* Stm.) with its parasite. Natural size.

with minute yellowish eggs of a nearly spherical form. From three hundred to three hundred and fifty eggs are contained in this cavity; the latter being formed by the prolonged lamellate margins of the thoracic segments.

The body of the female is of a whitish color, and as in all

¹ Jenaische Zeitschrift für Medicin und Naturwissenschaften, Vol. vi, 1, p. 53, 1870. Dr. Fritz Müller. (Bopyrus and Cryptoniscus.)

² Read before the 30th meeting of the A. A. A. S., August, 1881. In this paper the Bopyrus was provisionally called *B. manhattensis*.

³ See also my note in *Scientific American*, Vol. xli, No. 10, September 3d, 1881.

⁴ *Annals Lyceum Nat. Hist. N. York*, Vol. x, p. 129, 1871.

⁵ *Zoology for High Schools and Colleges*. By A. S. Packard, Jr., M.D., Ph.D. 1881, 3d ed.

⁶ *Proceedings Academy of Nat. Sciences*, 1879. See also *Report on the marine Isopoda of New England*. By Professor Oscar Harger, p. 312.

members of this family, is somewhat distorted and unsymmetrical, one side having narrower segments than the other, and is therefore of a triangular shape.

Degeneration as a result of parasitism is manifested in the absence of eyes as well as antennæ proper, in the clumsy form of the feet and the much reduced mouth-parts. The head evidently consists of two unequal fleshy lobes. The dorsal cephalic lobe is triangular and somewhat unsymmetrically placed, the ventral lobe is of subquadrate shape, anterior angles produced, posterior angles rounded, with the middle of its posterior part prolonged and rounded.

Of the mouth parts I was unable to find more than one pair of maxillæ inserted at the sides of the ventral cephalic lobe. They constitute a flat, roundish, terminal piece, the palpus, with nine marginal hyaline tentacles;¹ the basal joint is connate with and obliquely inserted into the median lobe. A number of muscle-nerves (muscle and nerve together) run to the tip of the basal maxillary joint, some of which enter the palpus, others (three) distribute themselves along the outer tip of the former, entering three longer and stouter marginal tentacles. A beautiful dendritic arrangement of black pigment is found near the base of the palpus.

From underneath the body of the ventral cephalic lobe arise a number of narrow, ligulate, gill-like appendages, which are, in the live animal, kept in constant rapid paddling motion.² Viewed under higher microscopic power, they exhibit a granular structure with longitudinal, hyaline, evidently lacunary canals. If it was not for their abnormal position near the anterior part of the body and their structure, I should regard them as gills, but to be consistent, am obliged to see in them paddling organs for the purpose of aërating the eggs or embryos contained in the marsupium.

The seven pair of feet are curved forward and downward, and terminate in an indistinct hook-like knob. The black pigment is very irregularly distributed in the feet, some are all yellowish, others but slightly pigmented, and again others are nearly all black. This I have observed in live specimens, and it seemed to

¹ Compare with C. Spence Bate and J. O. Westwood's *History of the British sessile-eyed Crustacea*, Vol. II, p. 218, fig. 9.

² C. Spence Bate and J. O. Westwood, *op. citat.* p. 220. * * * furnished with two or three membraneous, flattened, pointed appendages.

me that, when black, the pigment is centrally located in the legs. The thoracic segments have, as apparently in all Bopyridæ, their margins prolonged into more or less lanceolate pigmented lamellæ. To these lamellæ the feet are attached. The lamellæ attached to the first pair of feet is a small, beautifully pigmented oval lobe, and its entire margin is fringed with delicate tentacles. The second and third pair of feet have very broad lamellæ, with forward directed sub-ovate tip, and with their anterior margins fringed. The fourth, fifth and sixth pair of foot-lamellæ are short, broad and irregularly triangular pieces; seventh lamella very long, narrow, lanceolate.

The marsupium is an open, roundish cavity, surrounded by the above-mentioned lamellæ, and covered by the carapace of the prawn.

The abdomen is deeply segmented, and ventrally provided with roundish appendages overlapping each other in the median line. I have closely observed the live females, and doubt that those abdominal appendages functionate as gills. They consist of a larger thick fleshy lobe, and a smaller, still thicker roundish piece. They are the degenerate postabdominal legs, characteristic of the order of Isopoda. Usually four, but sometimes six pairs of the thoracic epimera are more or less black pigmented.

The male averages about 1^{mm} in length by 0.25^{mm} in width. Head with a pair of lateral pigment eyes. Head and seven thoracic segments black pigmented, the pigment exhibiting, beside the ordinary form, a pretty stellar arrangement.

Anterior angles of thoracic segments oblique, abdominal segments four, pale, their margins perfectly round, segments gradually becoming narrower toward the terminal median piece, which is minute, and, on treating with acetic acid, is seen to consist of two lobes.

The last of the thoracic segments, not being as fully pigmented as all the preceding, exhibits dorsally a twisted, serpentiform (bretzel-shaped) marginal ornamentation.¹ Eight pairs of legs with powerful claws. Antennæ apparently two-jointed, first joint club-shaped, with five minute bacilli on its tip, second joint much narrower, about one-quarter as long as the first, with six bacilli at its tip.

¹ Similar to the male of *Cepon distortus* Leidy, Journ. Acad. Nat. Sc. Phila., Vol. III, 2d series, 1855 to 1858, Plate XI, Figs. 26 to 32.

The live males were removed from under the lobes of the abdomens of the females (one male in each female, and always on the same spot) and placed on paper wetted with salt water, where they slowly walked about in a sideways direction. The females moved their legs to and fro, and contracted their abdomen only on touching the ventral appendages. They kept rapidly paddling with their gill-like cephalic appendages as mentioned above. I presume that the male and female get their necessary aëration through the motions of the gills of the prawn, and as the embryos are laterally covered by the marsupial lobes of the females, and exteriorly by the carapace of the prawn, the additional fanning of the female cephalic appendages is intended for aërating the eggs or the embryos only. The functions of the gills in the carapace of the prawn infected with the Bopyrus, are undoubtedly impaired through the presence of the latter, thus shortening the life of the former; the lessened aëration conditions but one brood of the Bopyrus; both adults of the latter gradually die off *in ratio* with the prawn.² The embryos after quitting their larval skin,

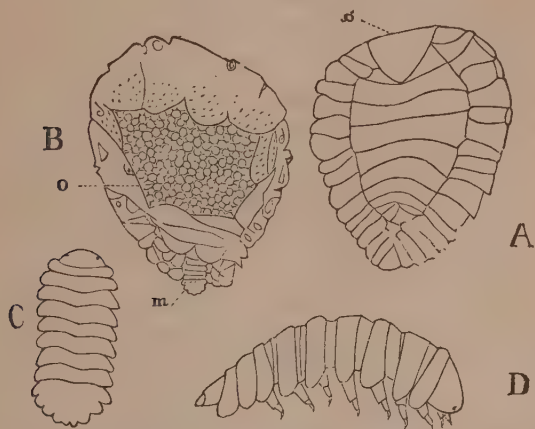


FIG. 2.—*Bopyrus palemoneticola* Pack., much enlarged. (From *Scient. Amer.*, Sept. 3, 1881). A, female Bopyrus, dorsal view; B, ventral view of same, C, dorsal view of male; D, male, side view; (B) e, eggs; m, male.

¹ This is also the case with *Cymothoa*, according to Professor J. C. Schiödte in *Annals Mag. Nat. History*, Ser. v, Vol. 2, 1878, p. 195. On the Propagation and Metamorphosis of the suctorial Crustacea of the family Cymothoidæ.

² The suggestion that the Bopyrus and its host die "in ratio" together, was supported by several experiments, by placing separately about half a dozen of both infected and healthy prawns into quart jars full of marine water, wherein in every instance the infected prawns died several hours before the non-infected ones.

are, what Bate and Westwood have already hinted at, in their highest and most advanced stage; the organs of sense and motion being proportionately larger and better developed at that period of their existence than ever after. In this free stage the young get their aëration through the entire integument. I suppose that after the brood of larvæ have left the marsupium of the female, they will actively swim about in the sea, attaching themselves, if possible, to egg-clusters of female prawns;¹ with the young of the latter they simultaneously grow up, and enter their branchial cavity in pairs at an early period of life.

In June, 1881, I found a few (out of several hundred) live females with males, the former with empty marsupia, which fact led me to believe that this *Bopyrus* may produce more than one brood, but the few cases may either be exceptions or, what is more likely, the broods had just left their marsupia, leaving the parents to their fate.

The following observations were made on the eggs and embryos taken from the marsupium of live female specimens. The specimens were obtained during May, June and July this year (1881), and the number of more advanced developmental stages was not at all augmented in the latter month, nor was this the case with a lot received late in August. By far the greater number of prawns, regardless of sex,² exhibited through their transparent carapace the yellowish eggs of the female *Bopyrus*, nearly all, with but a few exceptions, showing under the microscope the peripheric blastoderm cells within which a larger or smaller, entire or subdivided yolk-mass could be distinguished (see Pl. I, fig. 1). The few exceptions just mentioned showed, when viewed from the side, the budding limbs and segments very indistinctly, the two body-ends however, head and tail (pleon) being more distinct, exhibiting the form seen in Pl. I, fig. 3. Those prawns which showed through their swollen carapace a more grayish mass, contained the *Bopyrus* embryos invariably in their larval skin, a drawing of which is seen in Pl. I, fig. 2.

These embryos contained a central undifferentiated yolk-mass, with a few yellow oil-globules and some larger orange-colored

¹ Bate and Westwood, p. 217.

² Dr. Heinrich Rathke (I quote from Bate and Westwood, p. 217) found the female *Bopyri* upon female prawns, of which he had observed several hundreds thus infected, whilst quite as many male prawns were found to be free from their attacks.

pigment masses, the latter being nearer the dorsal line. It must be understood that the embryo in Isopod crustaceans is bent backward, head and tail nearly touching each other, the limbs, on the other hand, being in the peripheric layer. In Fig. 4 an embryo is shown freed from the egg-skin or chorion, thereby turned into its opposite direction, concave ventral and convex dorsal side. A pereopod or thoracic leg; the end of the abdomen (telson) with the last pair of legs (uropods), a pleopod, one of the second pair of antennæ with *dd*—? remnants of earlier embryonic bristles—are shown respectively in Figs. 4, 4 *a*, 4 *b*, 4 *c*, and 4 *d*. By working with the dissecting needles, the embryo (in Fig. 4 freed from the chorion, but still enclosed in its larval skin) with some difficulty could also be freed, limb after limb, from its larval skin (amnion), then appearing as in the much enlarged Fig. 5. This, as has already been said, is the highest and most advanced stage of the Bopyrus, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will deform into the abdominal lobes and from the seventh free segment will bud a pair of legs. But if a male, where does the eighth pair of thoracic legs originate from? From the first pair of pleopods? I should rather infer that the pair of uropods will yield the eighth pair of legs in the male. The fact that the male has no abdominal appendages (so-called gills of the female) gives strength to the assumption that the eighth pair of legs in the male are derived from one pair of the pleopods, since the former (female) have the same origin.

EXPLANATION OF PLATE I.

FIG. 1.—Egg after segmentation.

- a*. Blastoderm-cells.
- b*. Subdivided central yolk ball.

FIG. 2.—Later stage. Lateral view.

- c*. Head.
- a*. Chorion.
- b*. Larval skin—amnion.
- aa*. Mandibles.
- bb*. Maxilla.
- i*. Antennula.
- ii*. Labrum.
- iii*. Antenna.
- iv*. Maxilla?
- y*. Yolk with orange pigment balls.
- z*. The six thoracic legs (Pereiopoda).

XI. Seventh free thoracic segment.

o. Twelfth to sixteenth segment (abdominal segments, pleopods concealed).

t. Telson, uropods covered beneath the dorsal bent.

FIG. 3.—Profile view of embryo; dorso-ventral.

a. Head.

b. Pleon.

FIG. 4.—Older embryo in larval skin. Lateral view.

FIG. 4 *a.*—Telson or fourteenth segment with the uropods of Fig. 4 in larval skin.

Highly magnified. Showing pigment.

FIG. 4 *b.*—One of the pereopods of larva (Fig. 4) in larval skin.

FIG. 4 *c.*—A pleopod of larva (Fig. 4) in larval skin.

FIG. 4 *d.*—Second antenna of the same stage.

dd. Remnants of earlier embryonic bristles?

FIG. 5.—Latest larval stage.

c. Head.

l. Labrum.

m. Mandibles (?) with labium.

antl. Antennula.

ant. Antennæ.

oc. Eye.

per. The six pereopods.

f. s. Seventh free segment.

plpd. The five pleopods.

t. Telson, bearing the

u. Uropods.

p. Orange pigment spots.

EXPLANATION OF PLATE II.

FIG. 6.—Stellar form of pigment of adult male; from dorsal side.

FIG. 7.—Leg of adult male Bopyrus.

FIG. 8.—Antenna of male B. magnified 500 $\times$.

FIG. 9.—One of the maxillæ with palpus of the female.

arthr. Original joint.

mn. Muscle-nerves.

p. Denticular pigmentation.

t. Maxillary palpus with nine tentacles.

l. Disconnected part (from the other half).

\beta. Anterior free lobe.

FIG. 10.—First thoracic lobe of female.

p. Pigment.

t. Tentacles.

FIG. 11.—Outline of one of the abdominal appendages (gills) of female.

l. Smaller, thicker lobe, put aside.

FIG. 12.—Schematic figure showing position of the two maxillæ underneath the cephalon.

(From the American Naturalist, January, 1882.)

A MARINE PLANARIAN AND ITS HABITATION.—In June, 1881, a very large female specimen of the common horse-shoe crab (*Limulus polyphemus*) came into my hands,¹ on the gills of which I observed a number of brown small bodies like seeds of some plant, together with living whitish worms, a dendrocœlous Planarian, the *Bdelloura candida* Girard.²

These worms were of various sizes, the largest (Fig. 1; side), measuring 16^{mm} in length and about 6^{mm} in width, by about 1^{mm} in thickness. They moved slowly and snail-like over the large lamellous gills, their body-margin, especially the anterior portion, having undulating motions, these being respiratory movements. On placing them in alcohol they became considerably wrinkled

and contracted. The larger ones had neither cephalic notches (which occur in some members of this family), nor eye-dots. The dorsal side showed a faint line running along and close to the entire margin. A large round muscular bag occasionally protruded³ from a little behind the middle of the ventral surface; this is the pharynx.

In alcoholic specimens a second roundish smaller opening could be seen a little behind the pharynx, the genital orifice. The alimentary system had about ten or eleven lateral sacs.

The seed-like brown bodies found together with the Planarians, I immediately took for their egg-cases, which proved to be correct upon opening some of them whence one or two young Planarians could be taken. They were of a cream color and more transparent than their parents. But strange enough, they had a pair of distinct eye-dots; which, I presume, in the adult have degenerated.

The pharynx, the genital orifice and even, the genital gland (Fig. 1 *g*) could be recognized. From analogy I infer the latter to be the male organs, the female glands having escaped my observation, since our worm is hermaphroditic. The movements of these young worms were more rapid than in the older ones.

The egg-cases were of various sizes, by far the greatest number, however, being 3.50^{mm} in length (excluding the stem), by 1.50^{mm} in width. They were plano-convex, the latter exteriorly, the former towards the gills. They consisted of a brown, homo-

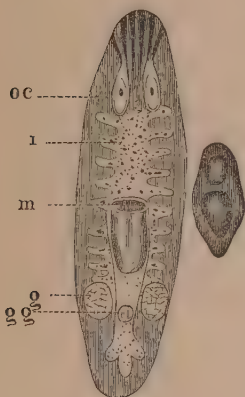


FIG. 1.—Young Planaria, 3mm long, extended. *oc*, eyes; *i*, alimentary system with lateral sacs; *m*, pharynx opening; *g*, male genital glands; *g2*, genital orifice. Figure at the side represents size and form of an adult Planaria.

¹ From Theo. C. Hepp, M.D., Brooklyn, N. Y.

² Identified by Professor A. S. Packard, Jr.

³ In alcoholic specimens in every case.

geneous, thick and leathery mass, either ovoid or cup-shaped, some of them having a sort of a lid on their tip.

Within many of them were the young Planarians, free, moving about, from one to three individuals in each capsule, in others the same were again enclosed within a similar oval case without stem, and again others were found with their tip broken off and empty. The greater

number of them were covered around their tip with bluish (colorless in alcoholic specimens) ten-pin-shaped tubes with open tips. As these tubes were invariably on or near the tip of the capsules only, they cannot be taken for parasitic organisms, but may presumably be openings for an

exchange of oxygenized water for the enclosed offspring. Those capsules having no such tubes, probably got them rubbed off through the motions of the gills of the *Limulus*. A few specimens of this Planarian, from three to five millimeters in length, the size usually found only within the capsules, were amongst the larger ones creeping around. These must have just left their protecting homes.—*Carl F. Gissler, Ph.D.*

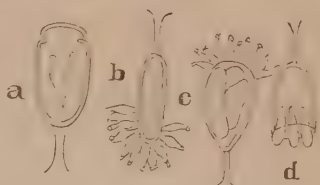


FIG. 2.—*a*, egg-capsule with a lid, enclosing two encased embryos; *b*, egg-capsule with one free young enclosed, capsule with air-tubes (?) around tip; *c*, ordinary form of egg-capsule, enclosing three young Planarians; *d*, empty egg-capsule with three empty cases near orifice.

W. M. Lockington
for J. S. Kingsley

(From the *American Naturalist*, July, 1880.)

RECENT ARTICLES ON CRUSTACEA.—About a year and a half ago a request was sent to the various museums of the world by Drs. Schiödte and Meinert, of Copenhagen, requesting the loan of all specimens of Cymothoidæ, for the purpose of monographing the group, and the first portions of the monograph have just ap-

peared.¹ From it we learn that only two American museums contributed, the Peabody Academy of Science at Salem, Massachusetts, and the Museum of Comparative Zoölogy, at Cambridge. The first of these papers treats of the Cirolanidæ, which closely resemble the true Cymothoas, but which differ in having the mouth parts adapted for eating flesh. Three genera and nine species are characterized, of which the genera *Barybrotos* and *Tachæa*, and the species *B. indus*, *B. agilis*, *T. crassipes*, *Corrallana collaris*, *brevipes*, *nodosa* and *hirsuta* are new. Each species is described as far as the specimens permitted, under three heads—male, virgin, and ovigerous females—the difference between the sexes and between the two forms of the same sex being very striking. In the second paper the Ægidæ are monographed. These Crustacea lead a parasitic life, generally attaching themselves to the roof of the mouth of fishes, and with their modified mouth parts, which form a sucking tube, living on the blood of their hosts. These forms are described under the following generic and specific names, those starred (*) being new: *Æga tridens*, *hirsuta**, *crenulata*, *webbii*, *stræmii*, *rosacea*, *scirripes*, *psora*, *deshayesiana*, *antillensis**, *magnifica*, *monophthalma*, *nodosa**, *ophthalmica*, *tenuipes**, *dentata**, *incisa**, *arctica*, *ventrosa* and *spongiophila*, *Rocinela danmonensis*, *insularis**, *dumerilii*, *maculata**, *americana**, *orientalis**, *australis**, *signata** and *aries**, *Alitropus typus* and *foveolatus**. Full descriptions are given of the male, virgin, ovigerous female and the young. The plates are engraved by Lövendal, the best living scientific engraver, and are simply beautiful; the text is in Latin, which is far better for the man of average education than would be the native language of the authors, and in short, the articles are models of scientific work.

Mr. Edward J. Miers has at various times since 1874 published several valuable papers on the Crustacea, some of which have been noticed in the pages of the NATURALIST. A number of these papers have been especially valuable from the fact that they embraced all the known species of certain families and genera. His twenty-third paper has just been received, and is of the same character as his "Revision of the Plagusinæ," "Notes on the Peneidæ," "Revision of the Hippidea" and "On the Classification of the Maioid Crustacea." In the present paper² the Mantis shrimps are monographed, fifty-three species being enumerated, distributed in six genera. There is one feature of Mr. Miers's work, which is to be especially commended; in these days of much species making, his tendency is just the reverse, and we

¹ De Cirolanis Ægas simulantibus commentati brevis scripserunt. J. C. Schiödte et Fr. Meinert. Naturhistorisk Tidsskrift III, XII, pp. 279–302, Pls. III–V (1879.)

Symbolæ ad monographium Cymothoarum Crustaceorum Isopodum Familiæ scripserunt J. C. Schiödte et Fr. Meinert.

² Ægidæ. l. c. pp. 321–414 Pls. VII–XIII (1879). From the authors.

³ On the Squillidæ. Annals and Magazine of Natural History for January and February, 1880, pp. 49, Pls. I–III.

think generally that he is right. As an instance of his onomastic spirit (to coin a word), the fifty-three species of Squillidæ have been described under seventy-six different specific names. The new species described are *Lysiosquilla brazieri*, *gonodactylus*, *excavatus* and *g-furcicaudatus*. A new genus *Septosquilla* is created for *Squilla schmeltzii* A. M.-Edw. and *Chloridella* is substituted for *Chlorida*, preoccupied. The plates are fair.—*J. S. Kingsley*.

A NEW SYNTHETIC TYPE.—At a recent meeting of the Zoölogical section of the Russian Association of Naturalists, Kovalevsky gave an account of *Caloplana metschnikowii*, a new form from the Red sea, intermediate between the Cœlenterates and the Planarian worms. In its outer form it resembles the Planarians; is gray above, white below, and about three lines in length by two in breadth. The mouth is a slit-like opening in the middle of the ventral surface, and communicates with a four-lobed stomach which resembles most nearly the "funnel" of the Ctenophora; from it originate a large number of canals which radiate to the periphery of the animal and open into a ring canal which bears many cæcal appendages. On the dorsal surface, almost directly over the mouth, is a vesicle containing a number of vibratile otoliths. On either side of this otocyst is a sheath from which can be protruded a long retractile tentacle. Each tentacle is branched and corresponds in shape to those of *Cydidippe* and *Eschscholtzia*, only they have no central canal but are composed of muscles. The nervous system and genitalia were not observed. The body is covered above with vibratile cilia.—*J. S. K., abs. Zool. Anzeiger*, III, p. 140, 1880.

Wm Lockington
Arthur Hays

(From the American Naturalist, July, 1880.)

PROGRESS OF AMERICAN CARCINOLOGY IN 1879.

BY J. S. KINGSLEY.

AMERICAN science, when compared with that of Europe, does not present a very creditable appearance. In the physical sciences almost every country of the old world is far ahead of the United States. With geology it is about the same, while in biology, American work, with a few conspicuous exceptions, has not surpassed a low state of mediocrity. The pages of the numerous scientific journals are filled with descriptions of new species, faunal lists and even worse nonsense, while anatomical and embryological papers are few and far between, and even then the majority of them are fragmentary and abound in errors of observation. In the philosophy of biology, America has done almost nothing. It is not the place in an article of this series, to insti-

tute an inquiry as to the reasons for this low condition of science. There is an institution in this country known as "The American Association for the Advancement of Science," surely a high sounding title; but would it not be well for the Association to begin to carry out its object? to do something for the advancement of science? Judging from the character of the papers published in its somewhat voluminous proceedings, it acts as a drag rather than an aid to progress. I might here add that aside from its grants of money to the Zoölogical and Geological Records, and to specialists to enable them to carry out certain lines of investigation, its British prototype is no more worthy of its pretentious name.

The American carcinological literature of 1879, may be considered under three heads, systematic, anatomical and developmental. Systematic papers have been published during the past year by Dr. Walter Faxon, Messrs. Oscar Harger, C. L. Herrick and J. S. Kingsley, Prof. A. S. Packard, Jr., Mr. John A. Ryder and Prof. S. I. Smith. Mr. Faxon gives an account of a species of *Lucifer*,¹ provisionally referred to the species *typus* of Milne Edwards. Mr. Ryder describes as new *Chirocephalus holmanii*² and *Streptocephalus sealii*,³ from New Jersey. Having seen specimens of the former species, I can say that it is not a species of *Streptocephalus*, as Dr. Packard seems to suspect,⁴ but truly belongs to the genus *Chirocephalus*, where Mr. Ryder placed it. Dr. Packard has recently⁵ proposed a new order, *Phyllocarida*, to receive *Nebalia* and its fossil allies; and in his recently issued Zoölogy⁶ has given a new classification of the Crustacea, which was repeated in outline in the December NATURALIST.

The work of Harger on the Isopoda of New England, Herrick on the Minnesota Entomostraca, and Smith on the New England Decapoda, have been already noticed in the NATURALIST, and hence need not be referred to again. Mr. Kingsley has contributed several short notes and reviews in the various numbers

¹ Description of *Lucifer typus* M. Edw.? Chesapeake Zoölogical Laboratory; Scientific results of the Session of 1878, pp. 113-119, Pl. VII, 1879.

² Description of a new species of *Chirocephalus*. Proc. Academy of Nat. Sci., Philadelphia, 1879, pp. 148-149.

³ Description of a new Branchipod, l. c., 1879, pp. 200-202.

⁴ AMERICAN NATURALIST, XIV, p. 53 (1880).

⁵ AMERICAN NATURALIST, XIII, 128, and *Annals and Mag. Nat. His.*, III, 459.

⁶ Zoölogy for Students and General Readers, N. Y., 1879.

of this journal, while in his paper on Decapoda,¹ he describes as new, eight species, *Microphrys error* and *Callinectes dubia* from the west coast of America, and *Mithraculus hirsutipes*, *Mithrax tri-spinosus*, *Lambrus granulatus*, *Panopeus packardii*, *Pilumnus dasy-podus* and *P. melanacanthus* from Florida. Notes are given on *Anaptychus cornutus*, *Mithraculus areolatus*, *Mithrax triangulatus*, *Panopeus affinis*, *P. purpureus*, *Xantho 9-dentatus*, *Chlorodius fisheri*, *Pachygrapsus transversus*, *P. gracilis* and *Calappa convexa*.

In anatomy almost no work has been done. Dr. Packard in his Zoölogy, gives a résumé of the structure of the Crustacea, but the additions to our knowledge of these animals is slight. A figure is given showing the differences between the eyes and brain of the blind craw-fish (*Cambarus pellucidus*) and another species with well developed eyes. A brief account of the visceral anatomy of *Serolis* is given, to which we must take exception, it being erroneous in several particulars. The writer contributed to the same work, figures of the nervous anatomy of *Idotea irrorata* and of *Serolis*, but they show no important differences from similar figures of other species of Isopoda.

It is in embryology that the valuable portion of American work on the crabs has been done, and here we have to record three papers on the development of these animals; two by Dr. Faxon and one by Dr. W. K. Brooks. Dr. Faxon in his first paper² gives figures showing the later egg-stages and the first stage after hatching of *Hippa talpoida*, so that with the previous paper of Prof. Smith on the same subject,³ we have a nearly complete life history of this species. In the first egg stage observed, the labrum, both pairs of antennæ, the mandibles and the telson are outlined (the "nauplius" stage). Both pairs of maxillæ and the first two pairs of maxillipeds appear previous to hatching, and in the first zoea stage no other appendages are indicated, but those mentioned acquire a greater development. The abdomen consists of four joints without appendages and the telson resembles somewhat strongly that of a larval shrimp. The gills are yet lacking, and although able to see the other vessels distinctly, our author could not discover the hepatic artery. Dr. Faxon

¹ Notes on North American Decapods. Proc. Boston Soc. Nat. Hist., xx, pp. 145-160, 1879.

² On some young stages in the development of *Hippa*, *Porcellana* and *Pinnixa* Bulletin of the Museum of Comp. Zoölogy, v, pp. 253-268, pls. I-V (June, 1879).

³ Transactions of the Connecticut Academy, III, pp. 311-342, pls. 45-48 (1877).

next discusses the growth of *Polyonyx macrocheles*. The last stages of the zoea obtained at Newport showed the enormously elongate spines of the carapax characteristic of the young of the porcelain crabs. All of the cephalothoracic appendages were present, the first two pairs of maxillipeds being large, biramose (schizopodal) and adapted for swimming. The third maxillipeds were rudimentary, and the ambulatory feet curled under the carapax. Six gills were noticed. The abdomen had six joints, and in the telson of those about to moult could be seen outlined the lacking segment with its appendages. From this stage the crab emerged at a moult without the intervention of a megalops stage. The young crab is nearly orbicular, and has not that "breadth of beam" characteristic of the adult, but resembles rather the genus *Pisosoma* of Stimpson. A bibliography of the embryology of the Porcellanidæ is given, but we notice that the figures of Guérin (in Ramon de la Sagra's *Historia física*, etc., de l'Île de Cuba, Paris, 1857) are not mentioned. The last species in the present paper is *Pinnixa chætopterana*, which in the last zoeal stage has four long spines, one rostral, one dorsal and one from each postero-lateral angle of the carapax, arranged much as in the oft-copied figures of the zoea of *Carcinus mænas*. The cephalothoracic appendages have acquired a more or less complete development, the last six, however, being concealed much as in *Polyonyx*. From this stage the crab develops directly, the young, however, not having the enlarged fourth pair of feet which characterize the genus, though the family characters are recognizable. In a supplementary note it is stated, on the authority of Prof. Smith, that a second species of *Pinnixa* found on the New England coast passes through a megalops stage.

The same author has worked out more completely the development of the common prawn of our coast,¹ and his paper forms a marked exception to the general poor quality of American biological work. In this species the cleavage of the yolk occurs in two planes almost synchronously, producing four cleavage spheres, from which the segmentation progresses regularly until the morula stage is reached. No polar vesicles were observed. The gastrula condition was discovered within twenty-four hours, but concerning the origin of the hypoblast we are told nothing.

¹ On the Development of *Palæmonetes vulgaris*. Bulletin Mus. Com. Zoöl., v, pp. 303-330, pls. I-IV (Sept., 1879).

The gastrula mouth soon closed. The first parts of the embryo to appear are the labrum, two pairs of antennæ, the mandibles and the abdomen, the latter very near the former position of the gastrula mouth. These parts appear almost simultaneously. Four days later both pairs of maxillæ and the first pair of maxillipeds have budded; in seven, the two remaining pairs of maxillipeds have appeared, all appendages showing a biramose character. The growth goes regularly on, the yolk being gradually absorbed, the eyes appearing at first as patches of dark pigment,¹ and when the prawn hatches there is a small simple eye at the base of the rostrum, the eyes proper are supported on short pedicels, the antennulæ are simple, the antennæ biramose, the future scale being much larger than the flagellum, the mandibles at no stage possess palpi. The scaphognathite (gill bailer) is in constant motion, though no gills are yet present. The three pairs of maxillipeds are two-branched, and their basal joints act as jaws, reminding one, as Dr. Faxon says, of the manducatory apparatus of *Limulus*. The ambulatory feet are represented by only two pairs of double sacks, the other three being undeveloped. The abdomen is six-jointed and without a trace of appendages. A moult brings two more ambulatory feet, and with the next exuviation the second antennal flagellum appears and the abdomen has seven joints, the sixth with its appendages appearing. After another moult two of the basal rostral teeth appear, the third pair of ambulatory feet acquire a natatory character, and the fourth and fifth pairs as well as the abdominal feet have budded. With two more moults the animal has acquired all its swimming feet, but differs from the Schizopoda (*Mysis*) in having the last pair simple, the exopodite being absent. In two or three more exuviations the exopodites are reduced to simple styles, and after a few more, the shrimp, then about eight millimetres long, acquires essentially the characters of the adult. Rostral teeth, however, continue to be added with growth.

Succeeding this account, summarized above, Dr. Faxon gives a critical review of the literature of the development of *Palæmon*, and we think him right in disagreement with Mr. Spence Bate regarding the homologies of the three pairs of appendages which appear first in the Crustacean embryo.

¹ I would here quote the foot-note on p. 308: "The development of the eye certainly lends no countenance to the idea that its stalk is an appendage homologous with the antennæ, etc."

The development of *Squilla*, by Dr. W. K. Brooks,¹ concludes our notice of the literature of American Crustacea for 1879. While the successive stages in the development of *Palæmonetes* were in most cases the result of the moulting of the larvæ in confinement, Dr. Brooks had to depend more upon the results of surface skimming for his younger stages, and hence his paper, though of great value, lacks the completeness of the last noticed one of Dr. Faxon. The first stage observed was that which formed the genus *Alima* of the earlier systematists; the eyes, both pairs of antennæ, mandibles, maxillæ and first two pairs of maxillipeds being present, the second pair possessing something of the raptorial character found in the adult. The eighth to tenth segments (9-11 Brooks) are differentiated, the eleventh to thirteenth (12-14 Brooks) are still united and all are without appendages. The abdomen consists of six joints, of which four bear appendages; the carapax with its long spines resembles somewhat that of the Decapod zoea. In the next stage the thoracic segments are all free. The third stage observed represents the changes of at least two moults, the remaining thoracic and fifth abdominal appendages being represented by small buds. The next form figured has the carapax and telson somewhat like those of the adult, while the appendages are all present, those of the abdomen, judging by the figures, having assumed something of their adult branchial character.

I would here return thanks to the various authors mentioned for copies of their papers.

¹ Larval stages of *Squilla empusa*. Chesapeake Zoölogical Laboratory. Scientific Results of the Session of 1878, pp. 143-170, pls. 9-13 (1879).

The Sexes of Sphæroma; by OSCAR HARGER.—In a recent memoir on Crustacea of the Coast of France, published in the *Annales des Sciences Naturelles*, 5^e série, tome xvii, 1872-3, M. Hesse has, with considerable hesitation, advanced the opinion that *Spæhroma* is only the female of *Cymodocea*, and that *Dynamene* is the female of *Næsea*. The hesitation of this author rests upon the fact, that the evidence in his possession was unsatisfactory and negative in character; and he laments his ill success in raising the young of these animals, significantly remarking of the offspring of *Sphæroma*, which he raised as far as the third moult, "Lorsque ces Crustacés sont parvenus à ce degré de transformation, ils ont la forme de leur mère, c'est-à-dire celle des *Sphéromiens*." In the case of *Dynamene* and *Næsea* less hesitation is expressed, and the absence, so far as known, of the former genus from this coast, cannot be considered as conclusive against the proposition. Neither has *Cymodocea* yet been obtained so far as I know on our coast, but *Sphæroma quadridentata* Say is not uncommon on the coast of New England south of Cape Cod, and, in any considerable collection of these animals, both sexes may be easily found. The sexes are readily distinguished by the second pair of pleopoda which, in the males, are furnished with a slender style, articulated to the inner or posterior lamella, and lying along its inner side. Near the middle of the ventral surface of the seventh thoracic segment of the males are two short, movable processes. In the females the plates, which during the breeding season are developed for the purpose of carrying eggs, are at other times small, and may be difficult of observation, but can usually be found as slender processes from the basal joints of the legs. Except in these sexual characters the two sexes closely resemble each other, and both belong to the genus *Sphæroma*.

Tube-building Amphipoda; by S. I. SMITH. — In examining recently an alcoholic specimen of a species of *Xenoclea*, I noticed a peculiar opaque glandular structure filling a large portion of the third and fourth pairs of thoracic legs, which in most, if not all, the non-tube-building Amphipoda are wholly occupied by muscles. A further examination shows that the terminal segment (dactylus) in these legs is not acute and claw-like, but truncated at the tip and apparently tubular. In this species, a large cylindrical portion of the gland lies along each side of the long basal segment, and these two portions uniting at the distal end pass through the ischial and along the posterior side of the meral and carpal segments and doubtless connect with the tubular dactylus. There can be no doubt that these are the glands which secrete the cement with which the tubes are built, and that these two pairs of legs are specialized for that purpose.

A hasty examination revealed a similar structure of the corresponding legs in *Amphithoe maculata*, *Ptilocheirus pinguis*, *Cerapus rubricornis*, *Byblis Gaimardi*, and a species of *Ampelisca*. In all these except the last two a very large proportion of the gland is in the basal segment. In the *Amphithoe* this segment is thickened and the gland is in the middle. In the *Cerapus* it is very broad and almost entirely filled by the gland, with only very slender muscles through the middle, and the orifice in the dactylus is not at the very tip but sub-terminal on the posterior side. In the *Ptilocheirus* the gland forms three longitudinal masses in the basal segment and is also largely developed in the meral and carpal segments. The dactylus is long and slender and the orifice sub-terminal. In *Ampelisca* and *Byblis* (which, like *Haploöps*, are tube-building genera) the meral segments of the specialized legs are nearly as large as the basal and contain a proportionally large part of the gland. In these genera the remarkable elongation of the two distal segments in the third and fourth pairs of legs is perhaps a special adaptation to enable them to reach back over the deep epimera.

The examination of fresh specimens will doubtless show these structures much more fully.

Description of Mancasellus brachyurus, a new fresh water Isopod ;
by O. HARGER.

THE genus *Asellopsis* * was proposed by the writer for the reception of *Asellus tenax* Smith, on account of the absence of mandibular palpi. A second species of this interesting genus has lately been collected by Mr. Fred. Mather, in Rockbridge Co., Virginia. Since the name *Asellopsis* proves to have been preoccupied I propose in its place *Mancasellus*,* retaining *M. tenax* as the typical species, while the new species may be called *M. brachyurus*, from the short caudal stylets. This species resembles *M. tenax*, described and figured in the Report of the United States Commissioner of Fish and Fisheries, Part II, Report for 1872-3, p. 659, plate I, fig. 3, differing principally from it in the following points : The lateral margins of the head are entire ; the proximal segment of the caudal stylets is short, being but little longer than the third segment of the antennæ ; the rami are also short, the inner being much stronger and somewhat longer than the outer ; in the males the propodus of the first pair of legs is armed with a prominent acute tooth on the palmar margin near the base, and, in the appendages of the seventh segment, the terminal portion of the outer pair is smaller and less expanded externally than in *M. tenax*, and the distal segment of the internal ramus of the inner pair is but little swollen at the base, and approaches the form seen in *Asellus communis* Say. The largest specimen measures 16^{mm}. in length exclusive of the antennæ and caudal stylets. The locality is worthy of mention as being on the Atlantic side of the Appalachian water-shed while *M. tenax* is yet known only from the Lakes.

* This Journal, III, vol. vii, p. 601, 1874.

† From *mancus*, maimed, and *Asellus*.

[FROM THE AMERICAN JOURNAL OF SCIENCE, VOL. XIX, APRIL, 1880.]

4. *On a collection of Crustacea from Virginia, North Carolina, and Florida, with a revision of the genera of Crangonidae and Palæmonidae*; by J. S. KINGSLEY. (From Proc. Acad. Nat. Sci. Phila. for 1879, pp. 383-427, pl. 14. No date: received March, 1880).—This, the longest of Mr. Kingsley's papers on American crustacea, notices about 100 species (9 of which are described as new), and is the most complete list yet published of the crustacea of the coast of the Southern States. It is based upon collections made by Prof. Webster of Union College. Decapoda only are included and of these the Pagurioidea are omitted. The paper covers partially the same ground as Mr Kingsley's "List of the Decapod Crustacea of the Atlantic coast, whose range includes Fort Macon" (op. cit., 1878, pp. 316-330), and is a marked improvement upon it. Attention should be called, however, to a few of the mistakes noticed in a cursory examination. In extending the range of *Leptopodia sagittaria* to Chili on the authority of A. Milne Edwards' identification of *L. debilis*

with that species, the author overlooks Milne Edwards' statement in the same paragraph that *L. sagittaria* Edwards and Lucas is a distinct species for which the name *modesta* is proposed. *Actæa spinifera* (sp. nov.) appears to be *A. acantha* A. Milne Edwards, which has been well figured twice; and if not Milne Edwards' species it should have been compared with it rather than with *A. hirsutissima*. *Eupilumnus Websteri* (gen. et sp. nov.), figured and very briefly described from a single specimen wanting the chelipeds, is evidently not very closely allied to *Pilumnus* and is apparently based on a young specimen of *Domacea hispida*, which had already been reported from the Florida reefs by Stimpson. Moreover, the name *Eupilumnus* is preoccupied, having been used (according to the Zoological Record for 1877) by Kossmann for a division of the old genus *Pilumnus*. In attempting, in a footnote on p. 405, to "straighten the synonymy of two species of *Petrolisthes*," the confusion in the synonymy of one of the species is increased. *Petrolisthes Helleri* is proposed for *Porcellana Danae* Heller (non Gibbes), regarded by Heller as the same as *Porcel. armata* Dana (non Gibbes). Dana, however, discovered that his name *armata* was preoccupied and, in the appendix to his great work, p. 1593, and in the explanation to the plates, substituted *spinuligera* for his species, though this has been overlooked by Stimpson and Heller as well as by Kingsley. The reason for the reference of the species to *Petrolisthes* is not apparent, for Stimpson retained Dana's species in the restricted genus *Porcellana* and, at least, it has no appearance of being a *Petrolisthes*.

Under Caridea there is a useful revision of the genera of Crangonidæ, Atyidæ, and Palæmonidæ, though one is occasionally left in doubt as to the limits of the genera adopted; as in the case of the first genus, *Crangon*, which is said to include *Steiracrangon* Kinahan, while no mention whatever is made of the same author's *Cheraphilus*, which has recently been adopted by G. O. Sars and by Miers. A peculiar misuse of "ibid.," which the proof-reader ought to have corrected, might be overlooked did it not recur so persistently in nearly all of Mr. Kingsley's papers. S. I. SMITH.

5. *The Crayfish: an Introduction to the Study of Zoology*; by T. H. HUXLEY. 371 pp. 8vo. New York, 1880 (D. Appleton & Co.)—This last volume of the International Scientific Series is far more interesting than ordinary text-books of zoology and well-deserving of careful study. Though it treats specially of the natural history, physiology, morphology, comparative morphology, distribution, and origin of crayfishes, it admirably fulfills the author's desire, as expressed in the preface, "to show how the careful study of one of the commonest and most insignificant of animals, leads us, step by step, from every-day knowledge to the widest generalizations and the most difficult problems of zoology." A large part of the excellent wood-cut illustrations are new, and many are unusually beautiful for a work of this class. The figures (after Bate) on page 282, are of *Carcinus mænas*, not *Cancer pagurus* as labeled.

S. I. SMITH.

Descriptions of new Genera and Species of Isopoda, from New England and Adjacent Regions; by OSCAR HARGER. Brief Contributions to Zoology from the Museum of Yale College.

THE genera and species described in the present paper are, except the first, marine and were, mostly, collected by the United States Fish Commission, along the New England coast. More complete descriptions with figures of all the new, and most of the old species, are nearly ready for publication in the Report of the Commissioner. As it seems desirable, however, to give a wider publication to the genera and species believed to be new, the following diagnoses are here inserted.

Actoniscus, gen. nov.*

Eyes small. Antennæ geniculate at the third and fifth segments; flagellum four-jointed. Terminal segment of maxillipeds lamelliform. Legs all alike. Pleon of six distinct segments. Basal segments of uropoda dilated and simulating the coxæ of the preceding segments; rami both styliform.

This genus belongs to the *Oniscidæ* and is near *Actæcia* Dana, MSS. (U. S. Expl. Exped., Crust., part II, p. 736, pl. 48, fig. 6), regarded as the young of *Scyphax*, but considered by Kinahan as the representative of a distinct family of the Oniscoidea.

A. ellipticus, n. sp. Body oval. Head with a prominent angular median lobe, and broadly rounded, divergent lateral lobes. Eyes oval, longitudinal, prominent, black. Antennulæ rudimentary. Antennæ nine-jointed; first segment short; second strongly clavate; third smaller, clavate; fourth flattened-cylindrical; fifth longest, slender, bent at the base; flagellum shorter than the fifth segment, composed of four subequal segments, tipped with setæ. Terminal segment of maxillipeds elongate triangular, ciliated and slightly lobed near the tip. First thoracic segment excavated in front for the head, shorter above than the following segments except the last, which is shortest. Legs small, scarcely spiny. Pleon continuing the regular oval outline of the thorax, apparently with four pairs of lamellar coxæ, the last pair are, however, the enlarged basal segments of the uropoda and are notched on their inner margins for the short outer rami, while the more slender inner rami are borne lower down on the under surface. The rami scarcely project beyond the general outline.

This species has been collected by Professor A. E. Verrill, at Savin Rock, near New Haven, and also at Stony Creek, in company with *Philoscia vittata* Say.

* From ἀκτή, the beach, and *Oniscus*.

Chiridotea,* gen. nov.

First three pairs of legs terminated by prehensile hands, in each of which the carpus is short and triangular, the propodus is robust and the dactylus capable of complete flexion on the propodus. Antennæ with an articulated flagellum. Head dilated laterally. Operculum vaulted, with two apical plates.

This genus is founded on *Ch. cæca* (*Idotea cæca* Say), which occurs on this coast from Florida to Halifax, Nova Scotia. It includes *Ch. Tuftsii* (*Idotea Tuftsii* Stimpson), of the New England coast from Long Island Sound to the Bay of Fundy, and, as constituted above, would also include *Ch. entomon* (*Idotea entomon* Bosc.), from the Baltic and other European localities, and *Ch. Sabini* (*Idothea Sabini* Kröyer), from the Arctic. The above mentioned species ought certainly to be separated from *Idotea tricuspidata* Desm., which may properly be regarded as the type of the genus *Idotea* Fabr.

Synidotea,† gen. nov.

Antennæ with an articulated flagellum. Epimeral sutures not evident above. Pleon apparently composed of two segments, united above but separated at the sides by short incisions. Operculum with a single apical plate. Palpus of maxillipeds three-jointed.

This genus is founded on *S. nodulosa* (*Idothea nodulosa* Kröyer), who appears to have been misled, in his unnatural description of the epimera, by the marginal thickening of the segments. He describes the epimera as evident even on the first segment.

Astacilla Americana, sp. nov.

Body nearly uniform in size throughout in the female, with the fourth thoracic segment narrow in the male, tuberculated. Head united with the first thoracic segment, and, together with it, twice the length of the next two segments; excavated in front, with the sides extending beyond the middle of first antennular segment, tuberculated above, crossed between and behind the eyes by two transverse grooves, while a third groove indicates the suture of the first thoracic segment. Eyes lateral, round-ovate, broadest in front. Antennulæ four-jointed, slightly surpassing the second segment of the antennæ in the female, nearly attaining the middle of the third in the male; basal segment swollen, nearly as long as the next two which are much more slender, last or flagellar segment shorter than the peduncle in the female, longer than the peduncle in the male. Antennæ about three-fourths as long as the body, fourth segment longest, then the fifth and third; first two segments short; flagellum three-jointed, short. First thoracic

* From *χέιρ*, a hand, and *Idotea*. † From *σύν*, with or together, and *Idotea*.

segment embracing the head, separated from it by sutures at the sides, but united in the dorsal region. Fourth segment longer than the other six segments together in the female, still more elongated in the male, in which sex it is longer than the three following segments with the pleon, while in the female it is only four-fifths as long; irregularly but not coarsely tuberculated, especially in the dorsal region. Last three segments with their epimeral regions produced into salient angular tubercles. Pleon elongate-ovate, tuberculated, a little longer than the last three thoracic segments, with three transverse grooves in the proximal region, the second continued at the sides, but showing no distinct suture. Immediately behind this is a prominent tooth on each side, directed outward and backward. Tip of pleon not spiniform but only slightly attenuated and obtuse. Opercular plates more than nine-tenths as long as the inferior surface of the pleon.

Length of female 10mm., male 11mm.; diameter of fourth thoracic segment, female 1.2mm., male 0.52mm. Of the two adult specimens obtained, fortunately a pair, the male, though much the more slender, actually exceeds the female in length. This relation of size in the sexes is unusual in the genus, the females being generally considerably larger than the males, but more specimens are necessary to prove the constancy of this proportion.

The specimens of this species were found adhering to *Primnoa*, from St. George's Bank.

Astacilla Fleming, is synonymous with *Leacia* (*Leachia*) Johnston, which is preoccupied.

Eurycope robusta, sp. nov.

Body oval, smooth and polished, breadth nearly equal to half the length. Head longer than the first thoracic segment, produced medially into a short rostrum about half as long as the basal antennular segments. Antennulæ attaining the middle of the fourth antennal segment; basal segment subquadrate, bearing the second, much smaller, segment beyond the middle of its superior surface; third segment slender; flagellum about twice as long as the peduncle, multiarticulate. Antennæ thrice the length of the body at least in the female; first three segments short; fourth and fifth slender, subequal and together as long as the body in the female; flagellum long, slender and multiarticulate. External lamella of maxillipeds subrhombic, with the inner angle much rounded, the outer prominent but not acute. First four thoracic segments short; fourth widest, fifth and sixth suddenly twice as long; seventh much the longest of all. First pair of legs shorter than the body; carpus exceeding the propodus; second pair longer than the body; third and fourth increasing slightly in length; carpus and pro-

podus subequal in all, armed, in the second pair only, with spines. Swimming legs (last three pairs) robust, carpus sub-circular, dactylus usually about half as long as the propodus. Pleon broader than long. Uropoda short, rami cylindrical, spiny at the tip; the outer more slender but not shorter than the inner. Length of body 4.5mm. Carpus of first pair 1mm.; propodus 0.6mm.; of second pair, carpus 1.5mm., propodus 1.6mm.; of fourth pair, carpus 1.5mm., propodus 1.7mm. Color, in alcohol, pale honey-yellow.

This species was dredged in 220 fathoms, in the Gulf of St. Lawrence, by Mr. J. F. Whiteaves.

Ægathoa loliginea, sp. nov.

Body elongate oval, not suddenly narrower at the base of the pleon, which is slightly dilated at the last segment. Head subequally, but not deeply, lobed behind, the lateral lobes being formed by the large, semi-hexagonal, coarsely reticulated eyes, which cover half the upper surface of the head. Antennulæ as long as the head, eight-jointed, separated at their bases, tapering to the tip; antennæ more slender, ten-jointed, surpassing the antennulæ by the last two segments, like the antennulæ without evident division into peduncular and flagellar segments. First thoracic segment shorter than the head and but little broader, not embracing it at the sides, longer than the following segments, which increase in width to the fifth; seventh shortest. Epimera short and obtuse, not surpassing the rounded posterior angles of the segments. Legs nearly alike throughout, first pair a little more robust, last pair slightly the longest, all with strongly curved dactyli. Pleon longer than the thorax, tapering to the fifth segment. First pair of pleopoda with the basal segment large, nearly square; last pair, or uropoda, surpassing the telson: basal segment triangular with the inner angle acute but scarcely produced; rami flat, the outer with slightly divergent sides, obliquely rounded at the end; the inner broader, triangular, with the outer side longest; cilia very short almost rudimentary. Length 13mm., breadth 3.6mm. Color in alcohol yellowish with minute black specks, most abundant on the pleon. Eyes black.

The only specimen in the collection was obtained by Mr. S. F. Clark, at Savin Rock, near New Haven, from the mouth of a squid (*Loligo Pealii*), whence the specific name.

Ptilanthura, gen. nov.*

Antennulæ with the flagellum remarkably developed, multi-articulate, second and following segments provided with an incomplete, dense whorl of fine slender hairs. This whorl is interrupted in each segment upon its internal or anterior side,

* From *πτερόν* a plume, and *Anthura*.

which, however, in the ordinary reflexed position becomes the external side. Eyes distinct, visible both above and below. Pleon imperfectly segmented, elongate. Maxillipeds two-jointed.

P. tenuis, sp. nov. Body smooth, slender, flattened above, broadest at the base of the pleon. Head broader but shorter than the first thoracic segment, narrowed to a point in front and less acutely behind. Eyes prominent, black, within the margin of the head. Antennulæ, when reflexed, attaining the third thoracic segment; first segment large but not longer than the second; third shorter than the second, followed by a short first flagellar segment, second and following segments about twenty in number, obconic, fitting into each other, flattened and naked on one side, which is the outer and somewhat inferior side in the reflexed organ, densely elongate-ciliate distally, except on the flattened side; cilia attaining about the fifth following segment. Antennæ hardly surpassing the peduncle of the antennulæ, eight-jointed. Maxillipeds with a quadrate basal segment, emarginate externally for the subtriangular external lamella, and bearing a single scarcely smaller terminal segment, truncate and ciliate at the tip. Thoracic segments slender, margined, the seventh but little over half as long as the others. First pair of legs moderately enlarged, segments well separated, dactylus strong, shorter than the inner margin of the propodus; remaining pairs of legs slender. Pleon about as long as the last three thoracic segments, first five segments consolidated along the median line, each rising into a low broad tubercle on each side of the median line; last segment as long as the preceding five; telson elongate-ovate obtusely pointed. Uropoda equaling the telson. Length 11mm., breadth 0.9mm., color in life brownish and somewhat mottled above, lighter below.

This species has been found on the New England coast from Noank Harbor, Conn., to Casco Bay, Maine.

Paratanais algicola, sp. nov.

Tanais filum Harger, Rep. U. S. Com. Fish and Fisheries, part 1, p. 573. 1874, *non* Stimpson.

Eyes conspicuous, black, plainly articulated, larger in the males. Antennulæ in the females three-jointed, tapering, setose at the tip, first segment as long as the last two which are subequal; elongated and eleven-jointed in the male, the first segment long, curved upward near the base, last eight segments with olfactory setæ. Antennæ short, five-jointed, deflected, fourth segment longest. First pair of legs robust, hand short and stout in the female, digital process scarcely toothed, bearing three setæ near its inner margin; hand in males strongly chelate, digital process elongated, curved, two-toothed; dactylus curved, slender, with about seven setiform spines on its inner margin; carpus in the males long and stout.

Second pair of legs elongated, basis flattened and curved, dactylus slender but shorter than the propodus. Bases of last three pairs of legs swollen. Uropoda bearing setæ at the tips of the segments, biramous; outer ramus short, scarcely if at all surpassing the basal segment of the inner ramus which is six-jointed and tapering. Length 2.2mm., breadth 0.33mm. Color nearly white.

This species is rather abundant among eelgrass and algæ at Noank and Woods-Holl, and probably other localities on the southern shore of New England. I formerly considered it as identical with *Tanais filum* Stimpson and supposed its range to extend as far as the Bay of Fundy. I now regard that as an error, as it is probable that *T. filum* is a true *Tanais* with simple uropoda, though I have as yet seen no specimens from the Bay of Fundy, nor any fully answering to Stimpson's description.

Paratanais limicola, sp. nov.

This species considerably resembles the preceding, but may be distinguished from it by the following characters: The eyes are small and rather inconspicuous, at least in the females, being only about half the vertical diameter of the antennulæ. The antennulæ have the second segment short, about half as long as the third. The dactylus of the second pair of legs, with its slender, acicular, terminal spine is longer than the propodus. The pleon is not dilated at the sides. The uropoda have the outer ramus two-jointed, slender, and surpassing the basal segment of the inner ramus which is five-jointed, with the basal segment long and imperfectly divided. Length 2.5mm.

This species was obtained on a soft muddy bottom in forty-eight fathoms, Massachusetts Bay, off Salem, in the summer of 1877, by the United States Fish Commission.

Paratanais cæca, sp. nov.

Body slender, elongated and loosely articulated. Head narrow in front, not broader than the bases of the antennulæ. Eyes wanting. Antennulæ four-jointed; first segment forming less than half its length; second segment longer than the third; last segment about as long as the second, slender, tapering and tipped with setæ. Antennæ attaining the tip of the third antennular segment. First pair of legs slender as compared with those of the preceding species, attaining the tip of the antennæ, basal segment subquadrate, hand or propodus less robust than the carpus; digital process of propodus serrated; dactylus short. Second (first free) thoracic segment two-thirds as long as the third, which is equal to the fourth and fifth; sixth and seventh progressively shorter. Second pair of legs scarcely more slender than the following pairs, basal segment not curv-

ing around the basal segments of the first pair. Pleon six-jointed; uropoda short, biramous, each ramus two-jointed, the outer more slender than the inner, half its length and bearing a long bristle at the tip. Length 2.5mm.

This species was taken along with *P. limicola* and unfortunately only a single specimen is as yet known.

Yale College, April, 1878.

Yale College, New Haven, Conn.

With the compliments of

Oscar Harger.

REPORT ON THE MARINE ISOPODA OF NEW
ENGLAND AND ADJACENT WATERS.

BY OSCAR HARGER.

[FROM THE REPORT OF THE UNITED STATES COMMISSIONER OF FISH AND FISHERIES,
PART VI, FOR 1878.]

XIV. REPORT ON THE MARINE ISOPODA OF NEW ENGLAND AND ADJACENT WATERS.

BY OSCAR HARGER.

The following paper includes the species of Isopoda at present known to inhabit the coast of New England and the adjacent regions, as far as Nova Scotia on the north and New Jersey on the south. These limits have been chosen from the fact that nearly all the marine collections of this order made by the Fish Commission have been from the New England coast, except those from the Nova Scotia coast in 1877, while the commission had its headquarters at Halifax. Previous to the work of the Fish Commission extensive collections had also been made, mostly by Professors A. E. Verrill and S. I. Smith, of Yale College, in the Bay of Fundy and at other places along the coast as far south as Great Egg Harbor, in the southern part of New Jersey. The collections thus obtained, and others in the museum of Yale College, have, through the kindness of Professor Verrill, been used in the preparation of this article. As there has not yet been sufficient opportunity for the study of the *Bopyridæ*, only a list of the known species of that family is included, and for this I am indebted to Professor S. I. Smith. The species of the remaining families are described at length, and nearly all figured in more or less detail in the plates accompanying the article. Throughout the article especial reference will be had to the Isopoda of our own coast, and many peculiarities of structure, not found in our genera, will be more or less completely disregarded. As the *Oniscidæ* are a terrestrial family, only a few species, found usually, or only, along the shore are here included.

ISOPODA.

This group is an order of Crustacea, so named from two Greek words, ἴσος, equal, and πούς, a foot, from the general similarity of the legs throughout, all being thoracic. The order belongs to the *Tetradecapoda*, "fourteen-footed," called also *Edriophthalma*, or "sessile-eyed" Crustacea. All of these terms, however, require modification when applied to the animals included in this order, since in the genus *Astacilla* the anterior pairs of legs are quite unlike the posterior, in *Gnathia* there are never more than twelve feet, or legs, in six pairs, and lastly in *Tanais* and its allies the eyes, when present, are not sessile, but articulated with the head, or stalked, as in the higher Crustacea. It may, however, be stated that

the relations of the *Tanaidæ* with the rest of the order are remote, and it is perhaps doubtful whether they should be retained among the *Isopoda*, especially as this family differs from the rest of the order in its mode of respiration, as will be explained hereafter.

Although this order is not a large one its representatives are perhaps more widely distributed than in any other order of Crustacea. Every one is familiar with "sow-bugs" or "pill-bugs," which are found even in damp houses and in cellars, as well as under leaves in woods or under almost any pile of rubbish among decaying vegetable matter. These terrestrial species do, indeed, become rare in the colder parts of the world, but are found as far north as Greenland. Other species less familiar, but perhaps hardly less abundant, inhabit ponds and streams of fresh water, and others are found along the shores of all oceans; yet others abound among the marine vegetation of the shallow waters, or fix themselves upon the bodies, or within the mouths of fishes and other marine animals. Species are found swimming free in the open ocean, and others are brought up from the greatest depths to which the dredge has yet penetrated.

It will be convenient to give here a brief general account of the structure of the animals composing this order, and an explanation of the terms used in their description. Most of our marine species have a greater or less number of the segments at the posterior end of the body coalescent, but in the genus *Cirolana* they are distinct; the animals are, moreover, of large size and very abundant in some localities; reference will therefore be constantly made to the figures of *Cirolana concharum*, on plates IX and X, in illustration of the parts of the animal and of the terms used. A few specimens of this animal will help materially in gaining a knowledge of the structure of the group; or, if specimens of *Cirolana* cannot be obtained, a common "sow-bug" (*Oniscus* or *Porcellio*) may be substituted.

The body appears to consist of fourteen segments, of which the first is the head; the next seven form the thorax, or pereion of Spence Bate, and the last six the pleon, sometimes called the abdomen. Returning to the head we find, looking from above, a pair of eyes—each consisting of a group of ocelli—and two pairs of antennary organs. Of these the upper pair, or antennulæ (pl. X, fig. 60), consist on each side of three comparatively large basal segments, which, together, are called the peduncle, or peduncular segments, and support a more slender and tapering flagellum or lash, composed of a considerable number of short segments, decreasing in diameter toward the tip, and each, usually, bearing a fascicle of setæ, which are called by Fritz Müller olfactory setæ, from their supposed function. The antennulæ are very small and rudimentary in "sow-bugs" and their allies. Below the antennulæ are the antennæ properly so called (pl. X, fig. 61 a), which are also composed of a peduncle and flagellum. The five basal segments constitute the peduncle, and the following, usually much shorter and smaller segments, are flagellar.

Underneath, the mouth is seen to be protected by a pair of organs called maxillipeds (pl. X, fig. 62 *a*), with which, for convenience of dissection, we shall commence the description of the parts of the mouth. The five terminal segments of the maxillipeds in *Cirolana* (numbered 1 to 5 in the figure) constitute the palpus, but this number varies in the different genera. They are articulated to the external surface of the large basal segment (*m*), usually proportionally much larger than in *Cirolana*, as in *Idotea phosphorea* (pl. V, fig. 28 *b, m*), or in the "sow-bug" where the palpus is greatly reduced. The basal segment of the maxilliped is, in general, produced internally beyond the origin of the palpus, and furnished with strongly plumose or pectinated setæ at the tip. Frequently along its inner margin one or more short styliform organs are attached, as in *Jæra albifrons* (pl. I, fig. 5), while along its basal margin is a more or less distinct suture, indicating the epimeral segment of this organ, which will be further explained. The basal segments of the opposite maxillipeds meet along the median line, where their margins are nearly straight, and to the base of the outer margin is attached a more or less triangular external lamella (pl. X, fig. 62 *a, l*). The name "maxilliped" is frequently used for the basal segment only, which is often, as in the "sow-bugs," much larger than the rest of the organ and serves to cover and protect the other organs of the mouth.

When the maxillipeds are removed we find two pairs of maxillæ, the outer and inner; of these the outer, or second pair (pl. X, fig. 61 *b*), are in general of a delicate texture, and three-lobed at the tip, the two outer lobes being articulated to the basal piece, and all three lobes ciliated on their inner margins. The inner, or first pair of maxillæ are of a less delicate texture than the outer, and are hardly of the ordinary form in *Cirolana* (pl. X, fig. 61 *c*); reference may, therefore, be made to *Synidotea nodulosa* (pl. VI, fig. 35 *c*), where the two unequal lobes are shown, the inner comparatively small, and supported on a slender peduncle, curved inward, truncated at the tip, and bearing stout, curved, pectinated setæ; the outer much more robust and larger, similar in general outline to the inner, but armed with stout, curved, denticulated spines at the tip.

The mandibles (pl. X, fig. 61 *d*) are usually toothed at the apex, the teeth being supported on a dentigerous lamella, which may be double on one mandible, usually the left, and receive the lamella of the opposite mandible between the two; below this lamella is often a comb of pectinate setæ, and, generally, a molar process, as in *Janira alta* (pl. III, fig. 12 *b, m*). In many genera a three-jointed palpus (pl. X, fig. 61 *d, p*) is articulated to the external surface of the mandible, and, usually, the terminal segment of the palpus is more or less semicircular, or curved, and bears on its inner margin a very regular comb of setæ (pl. III, fig. 12 *b*), apparently of service in cleansing the organs of the mouth. This comb may be continued or repeated on the second segment, as in *Cirolana* (pl. X, fig. 61 *d, p*). In the "sow-bug" and many other genera the

mandibles are destitute of palpi. The oral opening between the mandibles is defended by an upper and lower lip, or labrum and labium, which are, however, median, and not paired organs, like the other parts of the mouth.

The seven thoracic segments are of firm texture above, but softer underneath. The dorsal surface is in general more or less rounded, and in *Cirolana* is continued well down at the sides, where, except in the first segment, it is crossed by a suture cutting off a quadrate, or somewhat triangular piece, called an epimeron, or, in the plural, the epimera. The epimera are well shown in the side view of *Cirolana concharum* (pl. IX, fig. 58). They belong to the legs, and form a portion of the large proximal segment called the coxa. Usually, however, the legs are figured as in pl. X, fig. 62 *b*, without this segment, which adheres strongly to the body; often, as in the first segment of *Cirolana*, the suture separating it disappears. The remaining six segments of the legs are more slender, and are called respectively, beginning with the segment following the coxa, the basis, ischium, merus, carpus, propodus, and dactylus, the last being usually slender and curved, often bearing a curved spine or claw at the tip, and, especially in the first pair, capable of flexion on the propodus, so as to form a prehensile hand. In the *Tanaidæ*, as in many of the higher Crustacea, the propodus may be prolonged into a digital process, against which the dactylus closes, forming a chela (pl. XIII, fig. 85), or chelate hand, as in the lobster. In the *Ægidæ* and the *Cymothoidæ* a greater or less number of the dactyli are strongly curved or hooked, for the purpose of retaining firm hold of the host, on which these parasitic species live. Legs thus constructed are called ancoral, as in *Livoneca ovalis* (pl. XI, fig. 67 *d* and *e*).

Of the seven pairs of legs attached to the thorax or pereion, the first three have in general a resemblance to each other, and are often more or less prehensile, while, as in *Chiridotæa* (pl. IV, figs. 16 and 20), the last four are more strictly locomotive organs; but to this condition of things there are many exceptions, especially in the development of the first pair of legs, which are quite variable throughout the order, being not even pediform in the males of the *Gnathiidæ*, but two-jointed, in our species, and lamelliform (pl. XII, fig. 76 *d*). Except in this family, however, no confusion arises from speaking of the thoracic appendages as the first to the seventh pair of legs, or thoracic legs, and in general these terms will be used except where it may be necessary to use the technical terms, gnathopods or gnathopoda and pereopods or pereiopoda, for these organs, as proposed by Spence Bate, according to whose system the first and second pairs are called the first and second pairs of gnathopoda* or gnathopods, and the remaining five pairs the first to the fifth pair of pereiopoda or pereipods. When necessary these terms will be added as explanatory, having the merit of scientific accuracy as well as applicability to other groups of Crustacea, where a

* See also Edwards, Ann. Sci. nat., III, tome xvi, p. 221-291.

marked distinction of structure and function frequently occurs between the organs homologous with the second and third pairs of legs in the Isopoda.

In the adult females of this order there is commonly formed, on more or less of the under surface of the thorax, an incubatory pouch for the reception and development of the eggs. The outer surface of the pouch is usually formed by four pairs of lamellæ attached just within the origins of the second, third, and fourth, together with the first or fifth pairs of legs, and in the females of many genera, *Spharoma* and *Asellus* for instance, these lamellæ may be observed in a rudimentary condition on the under surface of the thorax when not actually in use carrying eggs or young. In *Asellus*, and in some other genera, they are found upon the first to the fourth segments, instead of the second to the fifth. In *Anthura* the incubatory pouch extends over only three segments, the third, fourth, and fifth; and in *Astacilla* it is confined to a single segment, being composed of a single pair of elongated plates attached to the fourth segment. In *Tanais* a further remarkable variation occurs, and the eggs and young are carried in sacs attached to the under surface of the fifth thoracic segment, while in the closely allied genus *Leptochelia* the form of the incubatory pouch is normal. In the *Gnathiidae* and *Anthuridae*, according to Spence Bate and Dohrn, the incubatory pouch is formed by the splitting of the integument of the inferior surface of the thoracic segments in the females, and for the discharge of the young the outer lamella thus formed further divides into scales, one pair for each segment of the pouch. In *Jara*, *Epelys*, and probably other genera, a similar mode of development seems to occur.

The six segments of the pleon are smaller than those of the thorax, often much smaller, and frequently more or less united, sometimes consolidated into a single piece with scarcely any trace of division above, but the number of pairs of appendages is generally six, showing the composite nature of the apparently simple organ. Of these six pairs of appendages or pleopods, the first five are more or less concealed beneath the pleon, and consist on each side of a basal segment bearing two lamellæ (pl. IV, fig. 19 *c*), of which the outer is the anterior when they overlap. These lamellæ, at least the anterior pairs, are usually ciliated along more or less of their distal margins with long slender plumose setæ. In the males of most of the genera, the inner lamella of the second pair bears, articulated near the base of its inner margin, a slender stylet (pl. IV, fig. 19 *b, s*). This stylet seems to afford, in many cases, specific and even generic characters.

The last segment, sometimes called the telson, has its pair of appendages specially modified, and called the uropods (pl. X, fig. 63). They consist in general like the pleopods of a basal segment bearing two lamellæ, or rami, not being always lamelliform, and in the *Tanaidæ* they are more or less segmented (pl. XIII, fig. 86). One of these rami may disappear, as in *Spharoma* and in some of the *Idoteidæ* (pl. V, fig. 25 *c*), where a further modification takes place, and the uropods are so articu-

lated to the inferior surface of the pleon as to fold together like a pair of cupboard doors, forming an operculum for the protection of the more delicate pleopods. Except in the *Tanaidæ*, respiration is carried on by means of the pleopods.

In the *Asellidæ*, *Idoteidæ*, and some other families two or more of the segments of the pleon are united, so that, seen from above, the pleon, like the head, may appear to consist of a single segment, as in *Jara albifrons* (pl. I, fig. 4), but the number of pairs of its appendages, usually six, remains as evidence of this consolidation. In like manner the head is to be regarded as composed of several segments united, and the number of such segments is indicated by the number of pairs of appendages. In the *Tanaidæ* and many of the higher Crustacea, the eyes, more or less distinctly stalked or articulated with the head, are seen to be of the nature of a pair of appendages, which may be regarded as belonging to the first cephalic segment. The antennulæ and antennæ represent, respectively, the second and third cephalic segments, and, in like manner, the mandibles and two pairs of maxillæ represent the fourth, fifth, and sixth segments of the head. A seventh segment is indicated by the maxillipeds. This segment is regarded by Huxley as properly thoracic* instead of cephalic, but, for purposes of description, the segment and its appendages will be regarded as belonging to the head, and the next segment considered the first thoracic.

This segment, like the following thoracic segments, is usually free, and has the dorsal region well developed, but in the adult *Gnathia* it is united with the head, and still more closely so in the *Tanaidæ*. The seventh thoracic segment is the last to develop, and in young Isopoda, taken from the incubatory pouch, only six pairs of legs are commonly found. In *Gnathia* this condition prevails through life, and in the adults the first pair of legs are also modified, especially in the males, so as to quite lose their pediform character, leaving apparently only five pairs of legs. Further modifications of structure will be described in the families and genera in which they occur.

The nomenclature adopted, as explained above, corresponds nearly with that proposed by Mr. C. Spence Bate in his Report on British *Edriophthalma*, and used by the authors of the British Sessile-eyed Crustacea.

The length of an Isopod, in the present article, is given as the length of the body, exclusive of appendages, and is measured from the front of the head to the tip of the pleon. When, as in *Janira*, the head is produced medially into a "rostrum" (see pl. II, figs. 9 and 10), the measurement is taken from the tip of the rostrum, which is a part of the head, and not properly an "appendage."

Among the *Edriophthalma* or sessile-eyed Crustacea, the *Isopoda* may in general be characterized as follows: Body depressed rather than compressed; respiration carried on by means of the pleopods, of which the last pair only are modified into uropods.

* Huxley, Anat. Inv., Am. ed., p. 276.

The body is said to be depressed, or flattened from above, in distinction from the form usually seen in the *Amphipoda*, where it is in general flattened from side to side. An important exception to the ordinary mode of respiration occurs in the *Tanaidæ*, as has already been mentioned. In this family respiration takes place in two lateral cavities, situated beneath the integument of a large cephalothoracic shield, covering the head and first thoracic segment. In general, as the name of the order indicates, the legs are similar in structure and function throughout, as in the "sow-bug," but may differ considerably, as in the *Arcturidæ*, the *Munnopsidæ*, and the *Tanaidæ*.

The arrangement of the families in the present paper can only be regarded as tentative, and no higher grouping will be attempted further than to indicate briefly the relationships of a few of the families to each other.

The *Oniscidæ* may, on account of their aërial respiration, be regarded as standing quite distinct from the remaining families, and should, perhaps, be further divided as proposed by Kinahan. As they do not, however, come within the proper scope of this article, I have not attempted to subdivide the family. The *Bopyridæ* have been placed near the *Oniscidæ* in deference to the opinions of Dr. Fritz Müller. Having made no study of this family myself I do not express any opinion as to the propriety of separating it so widely from the *Cymothoidæ*, with which it has usually been associated. The *Asellidæ* and *Munnopsidæ* are closely allied to each other. The *Idoteidæ* and *Arcturidæ* form a group distinguished especially by their operculiform uropods. The above families correspond nearly with the "marcheurs" or walking Isopoda of Edwards, and more nearly with the "gehende Asseln" of Müller. They usually have the antennulæ much less developed than the antennæ, and the uropods terminal or inferior, that is, attached to the end of the last segment, or in the last two families to its inferior surface.

The *Sphæromidæ* and *Limnoriidæ* are closely allied, and perhaps ought hardly to be kept separate as families. The *Cirolanidæ*, *Ægidæ*, and *Cymothoidæ* form another group embracing a wide diversity of forms, from the active predatory *Cirolana* to the sedentary and distorted *Livoneca*, and yet apparently connected by easy gradations. The remaining families are generally regarded as aberrant, and form the "Isopoda aberrantia" of Bate and Westwood. They do not present any very evident relationships with the preceding. Of these the *Anthuridæ* have usually been associated with the *Idoteidæ* or the *Arcturidæ*, or with both. Except an elongated form, however, they do not appear to have much in common with either of these families. According to Dohrn's observations they are related to the *Gnathiidæ* in the structure of the incubatory pouch. The *Gnathiidæ* have the head united with the first thoracic segment, as in the *Tanaidæ*, but this last family is widely separated from the others, and doubtless ought to be regarded as forming a distinct suborder, according to the views of Dr. Fritz Müller.

The arrangement of the families adopted, and to a certain extent their affinities, are indicated in the subjoined table, in which, however, as throughout the article, special reference is had to the representatives of the order in New England waters, extralimital species, genera, and even higher groups, *Apseudes* and the Serolids, for example, being disregarded. The arrangement will be seen to considerably resemble that of Dr. Fritz Müller. I have placed the *Tanaidæ* at the other end of the order, partly, however, from the necessity of a lineal arrangement.

SYNOPTICAL TABLE OF FAMILIES.

I. Respiration pleonal; legs not furnished with a chelate hand.

1. Legs in seven pairs.

a Antennulæ small or rudimentary; antennæ longer, often much elongated.

† Uropods terminal, sometimes rudimentary, rami mostly styliform.

Legs ambulatory; antennulæ rudimentary; respiration aerial.

I. ONISCIDÆ, p. 305

Legs prehensile; sexes very unlike; adult forms degenerate; parasitic II. BOPYRIDÆ, p. 311

Legs ambulatory or prehensile; segments of pleon united; antennæ with a multiarticulate flagellum III. ASELLIDÆ, p. 312

Last three pairs of legs natatory; segments of pleon united; antennæ with a multiarticulate flagellum IV. MUNNOPSIDÆ, p. 328

†† Uropods inferior, operculiform.

Legs prehensile or ambulatory, not ciliated V. IDOTEIDÆ, p. 335

First four pairs of legs ciliated; last three pairs ambulatory.

VI. ARCTURIDÆ, p. 361

b Antennulæ and antennæ subequal; body not elongated.

† Uropods lateral, with one ramus obsolete or subrudimentary.

Antennulæ and antennæ well developed; pleon of two segments; uropods with one movable ramus VII. SPHEROMIDÆ, p. 367

Antennulæ and antennæ short; pleon of six segments; outer ramus of uropods small VIII. LIMNORHIDÆ, p. 371

†† Uropods lateral, distinctly biramous; rami mostly lamelliform.

Mouth carnassial; legs not ancoral; antennulæ exposed in front; pleopods ciliated IX. CIROLANIDÆ, p. 376

Mouth suctorial; first three pairs of legs ancoral; antennulæ exposed in front X. ÆGIDÆ, p. 382

Mouth suctorial; legs all ancoral; antennulæ concealed at base by the projecting front; pleopods naked XI. CYMOTHOIDÆ, p. 390

c Antennulæ and antennæ subequal, or antennulæ much the largest in the males; body cylindrical, elongated.

† Uropods lateral and superior.

Legs ambulatory or prehensile XII. ANTHURIDÆ, p. 396

2. Legs in the adult in six, apparently only five, pairs.

Five pairs of legs ambulatory; antennulæ and antennæ subequal.

XIII. GNATHIIDÆ, p. 408

II. Respiration cephalothoracic; first pair of legs terminated by a chelate hand.

Legs ambulatory and prehensile; head united with the first thoracic segment; antennular flagellum single XIV. TANAIDÆ, p. 413

I.—ONISCIDÆ.

Antennulæ rudimentary; legs ambulatory; pleon of six distinct segments, of which the last is small; mandibles without palpi; uropods terminal.*

This large and important group of Isopoda being terrestrial in habit, only a few species are mentioned in this paper. They inhabit moist situations, and are commonly known as "sow-bugs," "pill-bugs," "wood-lice," &c. Several species may often be found under an old board or pile of rubbish. The genus *Ligia* Fabr. inhabits sea-shores, above tide-level, and a few other genera are found under heaps of seaweed, or burrowing in the sand along the shore. Three such species, belonging to as many genera, are here described and figured, but are less fully treated of than the marine species that follow in the other families. Other species, especially of the genus *Porcellio*, may be found in similar situations.

The family may be at once recognized by the apparent possession of only a single pair of antennæ. These are the antennæ properly so called, the antennulæ being minute and rudimentary. This is generally regarded as a character indicating a high degree of development, and causes them to somewhat resemble externally some of the shorter myriopoda, which, like other insects, have but a single pair of antennary organs. The maxillipeds are large and operculiform in this family, with short and few-jointed palpi. The mandibles are destitute of palpi.

The legs are rather weak and fitted only for walking, and usually more or less concealed by the projecting epimeral regions of the thoracic segments. The pleon, in our species, has its segments distinct and decreasing rapidly in size to the last, which bears the more or less exserted uropods. These organs may not, however, project beyond the general outline of the pleon, as they scarcely do in *Actoniscus*, while in *Armadillo* they assist in forming the very regular outline of that part of the body, which closes against the head when those animals, as is their habit, roll themselves into a ball on being alarmed.

This family is placed by Bate and Westwood in a separate "division," the "Æro-spirantia," on account of their aerial respiration. The air, however, requires to be saturated with moisture, and in some of the genera the respiration is, in part at least, aquatic. On this subject the reader is referred to the publications of Duvernoy and Lereboullet and of Nicholas Wagner.

Philoscia Latreille.

Philoscia Latreille, Hist. nat. des Crust. et des Ins., tome vii, p. 43, "1804."

Head rounded in front, not lobed; antennæ with its segments cylindrical, flagellum three-jointed; pleon suddenly narrower than the thorax; uropods exserted, basal segment broad, rami elongate.

* The above diagnosis would not include the genera *Tylus* Latreille nor *Helleria* Ebner, which perhaps ought not to be regarded as belonging to this family, although closely allied to it.

This genus may be recognized among our *Oniscidæ* by the rounded head without lobes, and the conspicuously narrowed pleon. Only a single species is as yet known from New England.

Philoscia vittata Say.

Philoscia vittata Say, Jour. Acad. Nat. Sci., vol. i, p. 429, 1818.

Dekay, Zool. New York, Crust., p. 50, 1844.

White, List Crust. Brit. Mus., p. 99, 1847.

Harger, This Report, part i, p. 569 (275), 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 157, 1879.

PLATE I, FIG. 1.

This species may be recognized, among our terrestrial Isopoda, by the absence of the usual antero-lateral processes on the head, in front of the eyes, and by the sudden contraction of the body at the base of the abdomen or pleon.

Body oval, smooth; about twice as long as broad; head nearly twice as broad as long; eyes large, occupying the antero-lateral regions of the head. The antennulæ are minute and concealed from above. Antennæ minutely hirsute, especially on the last three, or flagellar, segments, inserted below the inner margin of the eyes; first segment short; second about twice as long as the first; third equal in length to the second, clavate; fourth longer cylindrical; fifth longest, slender, cylindrical, straight; flagellum slender, three-jointed, longer than the fifth or last peduncular segment; first flagellar segment about one-half longer than the second; third longer than the second, tapering, tipped with a short transparent filament.

The first thoracic segment is longer than the following ones, which are of about equal length. The anterior angles of the first thoracic segment are somewhat produced at the sides around the head; the posterior angles are broadly rounded. The second and third segments have their posterior angles less broadly rounded, but not at all produced backward. In the fourth segment this angle is scarcely produced, but in the fifth, and still more in the sixth and seventh, it becomes produced and acute. The legs increase in size and length from the first to the seventh pair, and are well armed with spines, especially upon the inferior surfaces of the meral, carpal, and propodal segments. The spines on the latter segment are, however, much smaller than those on the merus and carpus.

The pleon is at the base about two-thirds as wide as the seventh thoracic segment. In the first two segments of the pleon the coxæ, or lateral lamellæ, are short, small, and nearly concealed by the seventh thoracic segment, but in the third, fourth, and fifth segments they are evident and acute but not large. The sixth segment is acute but not prolonged behind, and extends beyond the end of the basal segment of the uropod, which is broad and bears the two rami nearly on the same transverse line. The outer ramus, seen from above, is narrowly and obliquely lanceolate in outline, tapering to the tip, and surpasses by less than half its length the more slender, styliiform inner ramus. The uropods, the legs and antennæ, and the segments of the pleon, along their margin, are very minutely hirsute.

The color of these animals is dull and somewhat variable, usually brownish or fuscous, with lighter margins and two broad dorsal vittæ. Length 8^{mm}, breadth 4^{mm}.

This species has been found under rubbish and stones from Great Egg Harbor, ! N. J., to Barnstable, ! Mass. All the specimens that I have seen have been from the coast, although Say states that it is "very common under stones, wood, &c., in moist situations."

Specimens examined.

Number.	Locality.	Habitat.	When collected.	Received from—	Number of specimens.	Dry. Alc.
1222	Somers and Beesley's Points, N. J.	Shore	— —, 1871	A. E. Verrill and S. I. Smith.	25	Alc.
1911	Stony Creek, Conn.	do	— —, 1871	A. E. Verrill.	3	Alc.
2146	Vineyard Sound, Mass.	do	— —, 1871	U. S. Fish Com.	3	Alc.
1910	Barnstable, Mass.	do	Aug. 30, 1875	do.	3	Alc.

Scyphacella Smith.

Scyphacella, Smith, This Report, part i, p. 567 (273), 1874.

Antenna composed of eight distinct segments, with a geniculation at the articulation of the fourth with the fifth segment; terminal portion, or flagellum, composed of three closely articulated segments besides a minute apical one; mandibles slender; exposed portion of the maxillipeds formed of only two segments.

The genus *Scyphacella* was founded by Professor S. I. Smith, in part I of this Report, for the reception of the following species, the only one yet known. In regard to the relations of the present genus with *Scyphax* Dana* Professor Smith says: "This genus differs from *Scyphax* most notably in the form of the maxillipeds, which in *Scyphax* have the terminal segment broad and serrately lobed, while in our genus it is elongated, tapering, and has entire margins. In *Scyphax*, also, the posterior pair of thoracic legs are much smaller than the others, and weak; the last segment of the abdomen is truncated at the apex, and the articulations between the segments of the terminal portion of the antennæ, are much more complete than in our species. The general form and appearance of the genera are the same, and the known species agree remarkably in habits, the *Scyphax*, according to Dana, occurring on the beach of Parua Harbor, New Zealand, and found in the sand by turning it over for the depth of a few inches."

Scyphacella arenicola Smith.

Scyphacella arenicola Smith, This Report, part i, p. 568 (274), 1874.

Verrill, This Report, part i, p. 337 (43), 1874.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 157, 1879.

PLATE I, FIG. 2.

The small size, nearly white color, and peculiarly roughened surface of this Isopod will in general serve for its recognition, and the presence

* U. S. Exploring Expedition, Crustacea, p. 733, pl. 48, fig. 5.

of eyes will further distinguish it from *Platyarthrus*, which is often found inhabiting ants' nests, but would hardly be likely to occur in the sand of the beach.

Body elliptical, pleon not abruptly narrower than the thorax, dorsal surface roughened throughout with small depressed tubercles each giving rise to a minute spinule. Head transverse, not lobed; eyes prominent, round; antennæ longer than the breadth of the body; with the first and second segments short; third, fourth, and fifth successively longer and of less diameter; flagellum shorter than the fifth segment, composed of three closely articulated, successively smaller segments, and a very short somewhat spiniform but obtuse terminal one; all the segments, except the minute terminal one, beset with small scattered spinules.

First thoracic segment scarcely embracing the head at the sides; second, third, and fourth segments each about as long as the first, but increasing in breadth; fifth, sixth, and seventh diminishing in length and the last two also in breadth. Posterior lateral angles of the first three segments not at all produced, hardly perceptibly produced in the fourth segment; fifth, sixth, and seventh with the angles increasingly produced but not acute. Legs increasing somewhat in size posteriorly, armed, especially on the inferior surface of the meral, carpal, and propodal segments, with short stout spines.

Segments of the pleon with the coxæ but little developed. Terminal segment slightly rounded at the end, not attaining the end of the basal segment of the uropods, which are robust, with the basal segment spinulose, tapering to the base of the short, stout, outer ramus, and bearing the more slender inner ramus much nearer its base. The inner ramus is actually longer than the outer, but being inserted much lower down does not attain the tip of the outer ramus; both are tipped with setæ.

"Color, in life, nearly white, with chalky white spots, and scattered, blackish dots arranged irregularly. Eyes black." Length 3.4^{mm}.

This species was "found at Somers and Beesley's Points, on Great Egg Harbor!, New Jersey, in April, 1871, burrowing in the sand of the beaches, just above ordinary high-water mark, in company with several species of *Staphylinidæ*," and has also since been found by Professor Smith at Nobska Beach, Vineyard Sound!, Mass., in 1871, and by Mr. V. N. Edwards, on the beach at Nantucket Island!, December 6, 1877. It will doubtless be found at other points along the coast and toward the south.

Specimens examined.

Number.	Locality.	Habitat.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2136	Great Egg Harbor, N. J.	Sandy beach	Apr. —, 1871	S. I. Smith .....	.....	Alc.
	Nobska Beach, Mass	do	Aug. 18, 1871	do	2	Alc.
	Nantucket	do	Dec. 6, 1877	V. N. Edwards	1	Alc.

Actoniscus Harger.

Actoniscus Harger, Am. Jour. Sci., III, vol. xv, p. 373, 1878.

Eyes small; antennæ geniculate at the third and fifth segments; flagellum four-jointed; terminal segments of maxillipeds lamelliform, lobed; legs all alike; basal segment of uropods dilated and simulating the coxæ of the preceding segments of the pleon; rami both styliform.

This genus resembles *Actæcia* Dana* MSS., considered as the young of *Scyphax ornatus*, and found with it on the beach at New Zealand. Professor Kinahan,† on the other hand, regarded the genus as indicating a distinct family. The present genus differs from the description and figures of Professor Dana as follows: The flagellum of the antennæ consists of only four distinct segments instead of about six; the terminal segment of the maxillipeds is less distinctly lobed; the inner ramus of the uropods surpasses the outer, instead of falling far short of it; the outer ramus is styliform instead of being enlarged and subequal to the produced and enlarged outer angle of the basal segment.

Actoniscus ellipticus Harger.

Actoniscus ellipticus Harger, Am. Jour. Sci., III, vol. xv, p. 373, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 157, 1879.

PLATE I, FIG. 3.

This species may be at once recognized by the pleon, which appears to have four pairs of coxæ produced at the sides instead of three, as in *Oniscus* and other genera of this family. The last pair are, however, the basal segments of the caudal stylets, which are of peculiar form in this genus.

The body is oval in outline. The head appears triangular as seen from above, and is angularly produced in a median lobe, but the lateral lobes are also large and divergent, and broadly rounded. The eyes are small, oval, black, and prominent. They are situated at the sides of the median triangular part of the head, and at the base of the lateral lobes. The antennulæ are minute and rudimentary. The antennæ have the basal segment short; the second enlarged distally, especially on the inner side; the third forming an angle with the second, and clavate; the fourth flattened-cylindrical, longer than the third; fifth longest, slender, bent at base and forming an angle with the fourth; flagellum shorter than the last peduncular segment, tipped with setæ and composed of four segments, of which the second and third are equal and longer than the first, while the last is the shortest, and presents indications of another minute rudimentary terminal segment. The maxillipeds have the basal segment nearly twice as long as broad; the terminal segment elongate triangular, ciliated and somewhat lobed near the tip.

* U. S. Expl. Exped. Crust., part ii, p. 736, pl. 48, fig. 6 a-h.

† Natural History Review, vol. iv, Proc. Soc., p. 274, 1857.

The first thoracic segment is excavated in front for the head, admitting it about to the eyes. The next five segments are each a little longer than the first, but the last thoracic segment is the shortest. The first segment is dilated at the sides to about twice its length on the median line. The second, and in an increasing degree the succeeding segments are produced backward at the sides. The legs are rather small and weak and of nearly equal size throughout.

The first two segments of the pleon have their lateral processes, or coxæ, obsolete as usual in the family, but the third, fourth, and fifth segments are produced laterally into broad plates, which are close together, and, at their extremities, continue the regular oval outline of the body with scarcely a perceptible break between the thorax and the pleon. This outline is further continued by the expanded basal segments of the uropods, which are even larger than the adjacent coxæ of the fifth segment. At the extremity of the pleon both pairs of rami are visible, the inner springing from near the base of the basal segments below, the outer from a notch near the middle of the inner margin of the basal segment. The rami are tipped with setæ, and the inner just surpass the outer, which, in turn surpass the produced portion of the basal segments.

Length 4^{mm}, breadth 2^{mm}. Color in life slaty gray.

This species was collected by Professor Verrill, at Savin Rock, near New Haven!, and also at Stony Creek!, Long Island Sound, in company with *Philoscia vittata* Say.

Specimens examined.

Number.	Locality.	Habitat.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2137	Savin Rock, Conn....	Shore.....	— —, 1874	A. E. Verrill.....	2	Alc.
2138	Stony Creek, Conn....	do.....	.....	do.....	1	Alc.

The genus *Ligia* Fabricius* is recorded by Gould† from the timbers of a wharf, probably in Boston, and by Dr. Leidy,‡ with some doubt, from Point Judith, R. I., and the characteristics of the genus are therefore here briefly inserted, as follows:

Antennæ with a multiarticulate flagellum; basal segment of uropods exerted bearing two elongated cylindrical rami.

They are found usually in rocky places and under stones just above high-water mark. They are common on our southern coast, and are probably, at least occasionally, transported by accident within our limits. I have seen no specimens from nearer than Fort Macon, N. C.

* Suppl. Ent. Syst., p. 296, 1798.

† Invert. Mass., p. 337, 1841.

‡ Jour. Acad. Nat. Sci., II, vol. iii, p. 150, 1855.

II.—BOPYRIDÆ.

This family has not been studied, and only a list of the species, furnished by Professor S. I. Smith, is included. They are parasitic on Crustacea, and at maturity, the females especially, are generally much distorted and degenerate, often losing a great proportion of their appendages. The males are much smaller than the females, and of a more normal form, and they and the young forms must therefore be relied upon to indicate the affinities of this group to the rest of the order. According to Dr. Fritz Müller these forms indicate a relationship to the *Oniscidæ*, and especially to the genus *Ligia*, and in deference to his authority I have inserted them at this place.

Cepon distortus Leidy.

Cepon distortus Leidy, Jour. Acad. Nat. Sci., II, vol. iii, p. 150, pl. xi, figs. 26-32, 1855.

Harger, This Report, part i, p. 573 (279), 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 157, 1879.

Leidya distorta Cornalia and Panceri, Mem. R. Accad. Sci. Torino, II, tom. xix, p. 114, 1861.

"From the branchial cavity of *Gelasimus pugilator*, Atlantic City, New Jersey." (Leidy.)

Gyge Hippolytes Bate and Westwood (Kröyer).

Bopyrus Hippolytes Kröyer, Grönlands Amphipoder, p. 306 (78), pl. iv, fig. 22, 1838; Monog. Fremst. Slægten Hippolyte's nordiske Arter, p. 262, 1842; Voy. en Scand., Crust., pl. xxviii, fig. 2, 1849.

Edwards, Hist. nat. des Crust., iii, p. 283, 1840.

Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 140.

Gyge Hippolytes Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 230, 1868.

Buchholz, Zweite deutsche Nordpolfahrt, p. 286, 1874.

Metzger, Nordseefahrt der Pomm., p. 226, 1875.

Miers, Ann. Mag. Nat. Hist., IV, vol. xx, p. 64, (14), 1877.

Smith in Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 157, 1879.

Massachusetts Bay !, off Salem, on *Hippolyte spinus*, 30 fathoms, sand and mud, August 4, 1877; on *H. Fabricii*, 22 fathoms, gravel, August 4, 1877; on *H. securifrons*, 90 fathoms, soft mud, August 14, 1877. Casco Bay !, on *H. polaris* and *H. pusiola*, 1873. Bay of Fundy !, on *H. spinus* and *H. pusiola*, 1868, 1872. Off Halifax, Nova Scotia, 43 fathoms, September 27, 1877. Gulf of Maine !, 40 miles east of Cape Ann, Massachusetts, on *H. securifrons*, 160 fathoms, soft mud, August 19, 1877; also near Cashe's Ledge, on *H. spina*, 27 and 40 fathoms, rocks and gravel.

East side of Smith's Strait, north latitude 78° 30' (Stimpson). "Discovery Bay," north latitude 81° 44', Greenland (Miers). British Islands (Bate & Westwood). Scandinavian coasts (Kröyer *et al.*). Spitzbergen (Kröyer).

Phryxus abdominalis Liljeborg (Kröyer).

Bopyrus abdominalis Kröyer, Nat. Tidsskr., vol. ii, pp. 102, 289, pls. i, ii, 1840;
Monog. Fremst. Slægten Hippolyte's nordiske Arter, p. 263, 1842; Voy.
en Scand., Crust., pl. xxix, fig. 1, 1849.

Phryxus Hippolytes Rathke, Fauna Norwegens, p. 40, pl. ii, figs. 1-10, 1843.

Phryxus abdominalis Liljeborg, Öfvers. Kongl. Vet.-Akad. Förh., ix, p. 11, 1852.

Steenstrup and Lütken, Vidensk. Meddelelser, 1861, p. 275 (9).

Bate and Westwood, Brit. Sessile-eyed Crust., vol. ii, p. 234, 1868.

Norman, Rep. Brit. Assoc., 1868, p. 288, 1869; Proc. Royal Soc., London,
vol. xxv, p. 209, 1876.

Buchholz, Zweite deutsche Nordpolfahrt, p. 287, 1874.

Metzger, Nordseefahrt der Pomm., p. 286, 1875.

Miers, Ann. Mag. Nat. Hist., IV, vol. xx, p. 65 (15), 1877.

Smith in Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 158, 1879.

Massachusetts Bay!, off Salem, on *Pandalus borealis*, *Hippolyte spinus*, and *H. securifrons*, 48-90 fathoms, soft mud, August 13 and 14, 1877; also, on *Pandalus Montagu*, 35 fathoms, mud and clay nodules, August 10, 1877. Cashe's Ledge!, Gulf of Maine, on *Hippolyte pusiola*, 27 and 39 fathoms, rocky, September 5, 1874. Halifax!, Nova Scotia, on *Hippolyte pusiola*, 18 fathoms, fine sand, September 4, 1877; also, on *H. spinus*. About 30 miles south of Halifax!, on *Hippolyte securifrons*, 100 fathoms, fine sand, September 6, 1877.

Grinnell Land, in north latitude $79^{\circ} 29'$; and "Discovery Bay," north latitude $81^{\circ} 44'$ (Miers). Greenland (Kröyer *et al.*). British Islands (Norman *et al.*). Scandinavian coast! (Liljeborg *et al.*). Spitzbergen (Miers).

Dajus Mysidis Kröyer.

Dajus Mysidis Kröyer, Voy. en Scand., Crust., pl. xxviii, fig. 1, 1849.

Lütken, Crustacea of Greenland, p. 150, 1875.

? G. O. Sars, Arch. Math. Nat., B. ii, p. 354 [254], 1877 ("*D. Mysidis*?").

Smith in Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 158, 1879.

Bopyrus Mysidum Packard, Mem. Bost. Soc. Nat. Hist., vol. i, p. 295, pl. viii,
fig. 5, 1867.

? *Leptophryxus Mysidis* Buchholz, Zweite Deutsche Nordpolfahrt, p. 288, pl. ii,
fig. 2, 1874.

Labrador (Packard). Greenland (Kröyer, Buchholz). ? Off west coast of Norway (G. O. Sars).

Bopyrus, species.

Bopyrus Leidy, Proc. Acad. Nat. Sci., 1879, pt. ii, p. 198, 1879.

? Smith, Trans. Conn. Acad., vol. v, p. 37, 1879.

A species of *Bopyrus* is mentioned by Dr. Leidy as "a parasite of the shrimp, *Palæmonetes vulgaris*," occurring in the summer of 1879, at Atlantic City, N. J.

III.—ASELLIDÆ.

Antennæ elongated with a multiarticulate flagellum; legs ambulatory or prehensile, not strictly natatory; pleon consolidated into a scutiform segment, bearing terminal uropods, which may be nearly obsolete.

This family is represented on our coast by four species belonging to

three genera, and a species of another genus (*Asellus communis* Say) is common in the fresh-water ponds and streams of New England. The genus *Limnoria* Leach has been regarded by modern writers as belonging to this family, but will be found in the present article in the *Limnoriidæ* (p. 79). There remain then to be considered the genera *Asellus* Geoffroy,* *Jæra* Leach, *Janira* Leach, and *Munna* Krøyer, which, as represented in our waters, may be further characterized as follows:

The head is well developed, and in *Munna* is of large size; the body is usually depressed or but slightly arched, except that the pleon is vaulted in *Munna*. The eyes are present in our species though not throughout the family. The antennulæ beyond the basal segment are slender and are always much shorter than the antennæ, which are elongated and composed of a five-jointed peduncle and a slender multiarticulate flagellum. The first three peduncular segments are short; the last two elongated. The parts of the mouth are protected below by a pair of maxillipeds with large external lamellæ and five-jointed palpi. Within the maxillipeds are two pairs of maxillæ of the ordinary form; the outer or second pair delicate and three-lobed at the tip; the inner lobe being formed by the projecting basal segment, while the two outer lobes are articulated; all three lobes are provided with curved spiniform setæ. The inner, or first, pair of maxillæ present two narrow lobes; the outer lobe broader and more robust than the inner, and armed with robust curved spines, while the inner is tipped with much weaker setæ. The mandibles (see fig. 12 *b*, pl. III) are provided with one or two acute dentigerous lamellæ (*d*) at the tip, usually a comb of setæ and a strong molar process below (*m*), and a triarticulate palpus (*p*). This latter organ is, however, wanting in the genus *Mancasellus* Harger† from the Great Lakes and other fresh-water localities of North America.

The seven segments of the thorax are distinct from the head and from each other, and differ but little in general appearance throughout. The legs are mostly slender and elongated, except that the first pair may be more robust and better fitted for prehension. In our marine species the dactylus, at least behind the first pair of legs, is short and armed with two small claws or ungues, while the propodus is capable of considerable flexion on the carpus.

The segments of the pleon are united into a single piece, which is scutiform above, flattened or but little arched, except in *Munna*, and bears, at or near the tip, the biramous uropods, which are, however, nearly obsolete in *Munna*. The pleon often shows more or less trace of its compound character in imperfect transverse sutures on the dorsal surface near the base, and below it is excavated for the pleopods, the posterior pairs of which are delicate and branchial in their nature, while the anterior pairs

* "Hist. des Ins. t. ii" (Edw.). For information in regard to the common European form of this genus the reader should consult the admirable work of G. O. Sars, *Hist. nat. des Crust. d'eau douce de Norvège*.

† *Am. Jour. Sci.*, III. vol. xi, p. 304, 1876. See, also, *op. cit.*, vol. vii, p. 601, 1874, and *This Report*, part ii, p. 659, pl. i. fig. 3, 1874.

are variously modified in the different genera and in the sexes, so that much confusion has been introduced into the family by mistaking sexual for generic modifications of these organs. The branchial pleopods are usually protected by a thickened anterior pair, which, especially in the females of our marine species, may be consolidated into a single opercular plate, as will be further described. The incubatory pouch in the females does not appear to extend farther back than the fourth thoracic segment, and it may be confined to the second, third, and fourth segments.

In the last-mentioned, as well as in many other characters, this family is closely related to the next, and perhaps the *Munnopsidæ* may yet require to be united with it. Our species of the two families are at once distinguished by the last three pairs of legs, which are ambulatory in the *Asellidæ* and natatory in the *Munnopsidæ*. Our *Munnopsidæ* are, moreover, like the other known species of that family, destitute of eyes, while the marine *Asellidæ* have evident or conspicuous eyes, but the fresh-water genus *Cæcidotea* Packard* is blind, as are also certain foreign species referred to the present family. The relations of the *Asellidæ* with families other than the *Munnopsidæ* are less evident. They were associated by Professor Dana† with his *Armadillidæ* and *Oniscidæ* to form his subtribe *Oniscoidea*, and, *Limnoria* being excluded, the group appears to be a natural one.

Asellus communis Say, confined to fresh waters, and the only known New England representative of the genus, was described and figured by the present author, in Professor S. I. Smith's "Crustacea of the Fresh Waters of the United States," published in part II of this report (page 657, plate I, figure 4). Our marine representatives of the family may be most easily recognized by the consolidated pleon, ambulatory or prehensile legs, none of them natatory, and the slender, elongate antennæ. The genera may be distinguished by means of the following table:

Pleon	{ flattened above; uropods	short, subrudimentary	JÆRA, p. 314
		{ well developed	JANIRA, p. 319
	{ vaulted; head large		MUNNA, p. 325

Jæra Leach.

Jæra Leach, Ed. Encyc., vol. vii, p. "434" (Am. ed., p. 273), "1813-14."

Antennulæ short, few-jointed; antennæ moderately elongated; mandibles with palpi; first pair of legs similar to the following pairs; lateral margins of the thoracic segments projecting over the bases of the legs; uropods short, rami subrudimentary; pleon protected below in the females by a subcircular plate.

The short uropods and projecting lateral margins of the thoracic segments serve to distinguish this genus from its allies, and other characters of generic importance could doubtless be drawn from the pleon and its appendages, as well as from other parts of the structure, but, as it

*American Naturalist, vol. v, p. 751, figs. 132, 133, 1871.

†Am. Jour. Sci., II, vol. xiv, p. 301, 1862.

is represented in our limits by a single species, I have not been able to separate the generic from the specific characters with confidence, and have therefore described the species without attempting it.

Jæra albifrons Leach.

"*Oniscus albifrons* Montague MSS." (Leach).

Jæra albifrons Leach, Ed. Encyc., vol. vii, p. "434" (Am. ed., p. 273), "1813-14"; Trans. Linn. Soc., vol. xi, p. 373, 1815.

Samouelle, Ent. Comp., p. 110, 1819.

Desmarest, Dict. Sci. nat., tome xxviii, p. 381, 1823; *Consid. Crust.*, p. 316, 1825.

Latreille, Règne Anim., tome iv, p. 141, 1829.

Edwards, Annot. de Lamarek, tome v, p. 267, 1838; *Hist. nat. des Crust.*, tome iii, p. 150, 1840; *Règne Anim.*, *Crust.*, p. 204, 1849.

Moore, Charlesworth's Mag. Nat. Hist., n. s., vol. iii, p. 294, 1839.

Thompson, Ann. Mag. Nat. Hist., vol. xx, p. 245, 1847.

White, List Crust. Brit. Mus., p. 97, 1847; *Brit. Crust. Brit. Mus.*, p. 69, 1850; *Pop. Hist. Brit. Crust.*, p. 231, 1857.

Lilljeborg, Öfvers. Vet-Akad. Förh., Årg. viii, p. 23; 1851; *ibid.*, Årg. ix, p. 11, 1852.

Gosse, Man. Mar. Zool., vol. i, p. 136, fig. 243, 1855.

M. Sars, Christ. Vid. Selsk. Forh., 1858, p. 153, 1859.

Bate, Rep. Brit. Assoc., 1860, p. 225, 1861.

G. O. Sars, Reise ved Kyst. af Christ., p. (29), 1866; *Christ. Vid. Selsk. Forh.*, 1871, p. 272, 1872.

Norman, Rep. Brit. Assoc., 1866, p. 197, 1867; *ibid.*, 1868, p. 288, 1869.

Bate and Westwood, *Brit. Sess. Crust.*, vol. ii, p. 317, figure, 1868.

Metzger, J. B. Naturhist. Ges. Hannover, xx, p. 32, 1871; *Nordseefahrt der Pomm.*, 1872-3, p. 285, 1875.

Parfitt, Trans. Devon. Assoc., 1873, p. (18), "1873."

Stebbing, Jour. Linn. Soc., Zool., vol. xii, p. 149, 1874; *Ann. Mag. Nat. Hist.*, IV, vol. xvii, p. 79, pl. v, figs. 5-6, 1876; *Trans. Devon. Assoc.*, 1879 p. (7), 1879.

Meinert, *Crust. Isop. Amph. Dec. Dan.*, p. 80, "1877." (*Iaira*.)

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 158, 1879.

Jæra Krøyeri Zaddach, Syn. Crust. Pruss. Prod., p. 11, "1844" (*J. Krøyeri* Edwards?).

Jæra baltica Fried. Müller, Arch. Naturg., Jahrg. xiv, p. 63, pl. iv, fig. 29, 1848.

Jæra copiosa Stimpson, Mar. Inv. G. Manan, p. 40, pl. iii, fig. 29, 1853.

Packard, Canad. Nat. and Geol., vol. viii, p. 419, 1863.

Verrill, Am. Jour. Sci., III, vol. vii, p. 131, 1874; *Proc. Amer. Assoc.*, 1873, p. 369, 1874; *This Report*, part i, p. 315 (21), 1874.

Harger, *This Report*, part i, p. 571 (277), 1874.

Jæra nivalis Packard, Mem. Bost. Soc. Nat. Hist., vol. i, p. 296, 1867. (*J. nivalis* Krøyer?).

Asellus Grönlandicus Packard, loc. cit. (not of Krøyer).

Jæra marina Mübius, Wirbellos. Thiere der Ostsee, p. 122, 1873; *Ann. Mag. Nat. Hist.*, IV, vol. xii, p. 85, 1873. (*J. marina* Fabricius?).

Jæra maculata Parfitt, Trans. Devon. Assoc., 1873, p. "253" (18), "1873."

Stebbing, Trans. Devon. Assoc., 1879, p. (7) 1879, (*albifrons*).

PLATE I, FIGS. 4-8.

This species is at once distinguished from the other marine Isopoda of our coast by the short uropods, arising from a notch in the end of the

subcircular pleon. From the terrestrial forms, which it somewhat resembles, and in company with which it may sometimes be found, the above-mentioned character, joined with the multiarticulate flagellum of the antennæ, will serve to distinguish it.

The body is oval and flattened, a little more than twice as long as broad. The head is transverse, broadly excavated on each side over the bases of the antennulæ, sparingly ciliated on the lateral margins, with short scattered spine-like unequal cilia or setæ, which occur in a similar manner along the entire borders of the animal behind the front margin of the head. The eyes are prominent and black, situated near the posterior margin of the lateral regions of the head. The antennulæ are five-jointed, and do not surpass the fourth segment of the antennæ; the basal segment is large and separated from its fellow of the opposite side by about twice its diameter; the second segment is about as long as the first, but of much less than half its diameter; third segment shorter than the second, fourth still shorter, fifth tapering, tipped with setæ. The first three segments of the antennæ are short; the fourth is robust, and about as long as the first three together; the fifth is longest, and is followed by a slender elongated flagellum. The maxillipeds (pl. I, fig. 5) have the external lamella (*l*) short and broad, nearly straight on the inner margin, broadly rounded at the end, and somewhat swollen on the external side; the palpus (*p*) is five-jointed; the first three segments flattened, first short; second dilated internally and ciliated; third ciliate in the inner margin and narrowed to the base of the fourth segment, which is cylindrical; fifth short, conical. The terminal lobe of the maxilliped bears two rows of cilia near the apex, and on the inner side a row of short styliform organs. The outer maxillæ (pl. I, fig. 6 *a*) consist of a semioval portion, broad and ciliated at the tip, bearing above the middle two articulated lobes, armed with strong curved setæ at the tip. The inner maxillæ (pl. I, fig. 6 *b*) are armed with short stout spines, which are strongly spinulose on their inner curved side; inner lobe about half the diameter of the outer. Mandibles with a very much projecting molar process, a comb of pectinated setæ, and a dentigerous lamella, or two of them on the left side.

The first three thoracic segments are of about equal length along the median line, and are together nearly equal in length to the last four, which are also subequal along the median line, but the fifth segment appears shorter than the others on account of its short lateral margin, which has both its anterior and posterior angles strongly rounded. The epimeral region of the segments projects at the sides so as to cover the bases of the legs, and is squarish in the first three segments, rounded in the fourth, and still more so in the fifth, and obtusely angulated behind in the sixth and seventh. The legs are similar in form throughout, but increase in length to the last pair. They have the basis rather robust; the ischium shorter and flexed on the basis; the merus subtriangular, and tipped with spines; the carpus and propodus cylindrical, subequal

in length, but the carpus of larger diameter than the propodus; the dactylus short, cylindrical, and provided with two terminal hooklets. There are a few scattered spinules and setæ on the segments, especially the merus, carpus, and propodus. In the males the merus and carpus of the sixth and seventh pairs of legs are provided on their inferior margins with close-set slender curved hairs, which extend nearly the whole length of the carpus and over the distal half of the merus.

The pleon is proportionally broader and shorter in the male (pl. I, fig. 8) than in the female (pl. I, fig. 7). It is broadly rounded behind, continuing the outline of the body without break, and is notched at the tip for the insertion of the uropods, which scarcely project beyond the general outline of the body, and consist on each side of a short, stumpy, cylindrical basal segment, a little oblique at the end where it bears two almost rudimentary rami, the inner about twice as large as the outer, and both tipped with a few short setæ. The lateral margin of the pleon, like that of the body generally, is beset with short, scattered, unequal setæ or spinules. Underneath, the pleon is excavated for the branchial pleopods, which are covered and protected below in the females (pl. I, fig. 7) by a large subcircular plate, sparsely minutely ciliated on the margin. In the male (pl. I, fig. 8) the under surface of the pleon presents on each side a small oval plate, with its inner margin overlapped by a median elongated plate, divided by a central suture, which is open distally. This plate is broad at the base, then narrows toward the middle, after which it expands much more rapidly into an outwardly curved and pointed lobe on each side, ciliated at the tip. Between these two lobes the plate is terminated by two transverse, subquadrate and elongated lobes, which are broadest internally where they are separated along the median line. They are excavated on the anterior margin and less so on the posterior margin, sparsely ciliated behind, and conspicuously so with divergent cilia at the outer short, straight margin. In the females the incubatory pouch appears to be confined to the second, third, and fourth segments.

In size as well as coloration this species varies greatly, females being often found with eggs when less than half the size of the specimen figured. They attain a length of 5^{mm} and a breadth of 2^{mm}, but the males are at least one-third smaller and somewhat narrower than the females, the sides being more nearly parallel. In color there is also much variation. A common color is a dark, slaty gray, with dots or small blotches of yellowish, this color prevailing along the anterior margin of the head. Very frequently darker or lighter shades of green occur, and the incubatory pouch of the females is often bright green. Some specimens are very light colored or nearly white, often with two or more transverse dark bands, with considerable contrast in color; others are reddish brown throughout.

I am unable to separate the American form, *Jæra copiosa* Stimpson, from the common English and European species, although they have

hitherto been regarded as distinct. I have had no males from any European locality, but through the kindness of the Rev. A. M. Norman I have had an opportunity of comparing females from Oban, Scotland, with our species, and have found no specific differences. The description and figures given by Rev. T. R. R. Stebbing in the *Annals and Magazine of Natural History*, IV, vol. xvii, p. 79, pl. v, figs. 5 and 6, show a substantial correspondence in the males also, so that I have regarded the species as common to both coasts. Whether the Greenland species *J. nivalis* Kröyer, and the Southern species *J. Kröyeri* Edwards, are also identical with *J. albifrons* or not, I am unable to determine, in the absence of specimens for comparison. M. Sars says that he has seen specimens of *J. albifrons* Leach from Trieste, but regards the Greenland species as distinct. Möbius regards the species as identical from Greenland to the Mediterranean, and unites them under the name *J. marina*. Metzger, following Bate and Westwood, is more conservative, using the name *J. albifrons* Leach. Bate and Westwood regard *J. nivalis* Kröyer and *Oniscus marinus* O. Fabricius as doubtfully identical with *J. albifrons*, and *J. Kröyeri* Edwards as distinct. *J. Kröyeri* Zaddach = *J. baltica* Friedrich Müller appears to be, without doubt, identical with this species, as it is separated by that author from *J. albifrons* Leach only by the position of the eyes, which were incorrectly described by Dr. Leach as close together. I have, therefore, referred these two names to *J. albifrons* as synonyms, as has been done previously by Lilljeborg and others. *J. maculata* Parfitt, a species based almost wholly on color markings, I have referred to *J. albifrons*, following Stebbing, who believes that he is "in accord with the author of the species" in so doing.

This species is common, and in suitable localities abundant, on the whole coast of New England!, and extends as far north as Labrador! at least, where it was collected by Dr. Packard, who regarded it as identical with *J. nivalis* Kröyer. It is found among rocks, algæ, and rubbish along the shore, often nearly up to high-water mark, where it may be associated with some of the *Oniscidæ*, to which it has a certain resemblance in form. It occurs "probably" all around the coast of England (Bate and Westwood). I have examined specimens from Oban!, Scotland. It extends to Finmark, on the coast of Norway (M. Sars), and is common on all the coasts of the North Sea (Metzger). It is recorded by Möbius in the Baltic among stones and algæ down to a depth of 18½ fathoms. According to M. Sars this species extends to Trieste on the Adriatic, but without specimens I have not attempted to decide in regard to the synonymy of the Mediterranean species.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1921	New Haven, Conn.	.....	.....	May 1, 1871	.....	20	.....	Alc.
1917	Stony Creek, Conn.	.....	.....	.....	.....	8	.....	Alc.
1916	Noank Harbor, Conn.	.....	.....	—, 1874	U. S. Fish Com.	25	.....	Alc.
1915	Vineyard Sound, Mass.	.....	.....	—, 1871	do	1	♀	Alc.
1914	do	L. w.	Under stones	—, 1871	do	30	.....	Alc.
1920	Provincetown, Mass.	.....	.....	—, 1872	do	50	.....	Alc.
	do	.....	Shore	—, 1879	do	00	.....	Alc.
	do	.....	do	Aug. 13, 1879	do	00	♂	Alc.
	do	L. w.	.....	Aug. 13, 1879	do	15	.....	Alc.
	do	.....	Eel grass	Aug. 23, 1879	do	6	♂	Alc.
	Gloucester, Mass.	.....	Algæ	—, 1878	do	30	.....	Alc.
	do	.....	Tide pools	.....	do	7	♀	Alc.
	Casco Bay	.....	.....	—, 1873	do	.....	.....	Alc.
1919	Eastport, Me.	L. w.	Under stones	1868-1870	A. E. Verrill	7	.....	Alc.
1918	Eastport, Me., Dog Island.	.....	Tide pool	—, 1872	U. S. Fish Com.	5	.....	Alc.
1912	Indian Tickle, Labrador.	.....	.....	.....	A. S. Packard	7	.....	Alc.
519*	Hopedale, Labrador.	.....	Stone	.....	do	.....	.....	Alc.
	Oban, Scotland.	.....	.....	—, 1877	Rev. A. M. Norman.	4	♀	Alc.

* *Asellus grönlandicus* Packard, MSS.

Janira Leach.

Janira Leach, Edinb. Encyc., vol. vii, p. "434" (Amer. ed., p. 273), "1813-14".*Asellodes* Stimpson, Mar. Inv. Grand Manan, p. 41, 1853.

Body loosely articulated as in *Asellus*; antennulæ slender, with a multiarticulate flagellum; antennæ elongated, with a spine, or scale, on the second segment and with a long multiarticulate flagellum; mandibles palpigerous; lateral margins of the thoracic segments not completely covering the bases of the legs; first pair of legs prehensile; the carpus thickened, and the propodus slender and capable of complete flexion on the carpus; dactylus short and armed with two small ungues, as in the succeeding pairs of legs; uropods well developed, biramous.

This genus is represented on our coast by two species, one of which was originally described by Stimpson under the name *Asellodes alta*. It does not, however, seem to present any generic differences from *Janira maculosa* Leach, the type of the present genus. Stimpson's generic description appears to have been drawn from the male, as he says: "External pair of natatory feet having each two laminæ, like the others, but broader and hardened, so as to perform the office of an operculum." The two inner of these laminæ are, however, united along the median line nearly to the tip, as will be seen below.

Our species of this genus may be further characterized as follows: The body is elongate oval in general outline, between two and three times as long as broad. The eyes are distinct. The head is produced medially into a distinct rostrum, and the antero-lateral angles are also produced, but in the typical species (*J. maculosa* Leach) the head is rounded ante-

riorly. The basal segment of the antennulæ is enlarged; the second is more slender and cylindrical; the third is short, cylindrical, or slightly clavate, and is followed by a short subglobose segment having the appearance of a fourth peduncular segment. Beyond this, is a slender multiarticulate flagellum, composed of about twenty to thirty segments, the segmentation becoming indistinct toward the base. These segments are provided, except toward the base, with slender "olfactory setæ." The first three segments of the antennæ are short and robust, and the second bears, near its distal end, on the external side above, a triangular scale, or spine, articulated with the segment and directed forward, outward, and somewhat upward; the third segment is comparatively short and small; the fourth and fifth segments are slender and elongated, and the flagellum tapers from the base and is composed of many, 80 to 120 or more, segments. The maxillipeds (see pl. III, fig. 12 *a*) are broad, with a rhombic-ovate external lamella (*l*), and a five-jointed palpus (*p*), of which the first three segments are flattened and expanded internally, where the second and third segments are also ciliated. The last two segments of the palpus are cylindrical, and bent inward toward the median line. The outer maxillæ are rhombic in outline, ciliated and spiny along the inner margin and at the tip, as are also the two slender, curved, articulated lobes. The inner maxillæ consist of the usual curved lobes, armed at the tip with denticulated spines, which are larger, stronger, and more numerous on the outer large lobe. The mandibles are strong, and furnished with an acute dentigerous lamella on the right side, received between two such lamellæ on the left mandible; below is a comb of setæ and a strong molar process. The palpus of the mandible is composed of three subequal segments, the last furnished with a comb of setæ.

The thoracic segments do not greatly exceed the head in transverse diameter, and are subequal, the second, third, and fourth with a lateral emargination. The legs are slender and elongated, ambulatory, or the first pair subprehensile and somewhat shorter than the following pairs. In this pair the carpus is slightly swollen and the propodus is capable of complete flexion upon it. The dactyli are short in all the legs, as compared with the propodi, and capable of only incomplete flexion. They are armed at the tip with two robust unguiform spines.

The pleon is broad and flattened above. The uropods are well developed and consist of a cylindrical or slightly clavate basal segment bearing two rami of which the inner is the larger and longer. The under surface of the pleon is excavated, and in the females is protected beneath by a subcircular operculum, but in the males of *J. alta*, and probably in both species, the thickened opercular plates are three in number, viz, a pair of semi-oval plates at the sides and a more slender median plate presenting traces of a suture along the middle.

In the females, the incubatory pouch is formed of four pairs of plates attached to the coxal segments of the first four pairs of legs. These plates may usually be easily seen when the females are destitute of eggs.

being then small, elongate, oval, and lying near the under surface of the thoracic segments.

Janira alta Harger (Stimpson).

Asellodes alta Stimpson, Mar. Inv. G. Manan, p. 41, pl. iii, fig. 30, 1853.

Verrill, Am. Jour. Sci., III, vol. vi, p. 439, 1873; vol. vii, pp. 411, 502, 1874; Proc. Amer. Assoc., 1873, p. 350, 1874.

Janira alta Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 158, 1879.

PLATES II AND III, FIGS. 9, 12, AND 13.

This species may be at once distinguished from the following by the absence of spines in the dorsal and lateral thoracic regions, from all the other known Isopoda of the coast, by the flattened, scutiform and consolidated pleon, bearing well-developed, exerted, biramous uropods, which are, however, fragile. It is more slender than the following species.

The body is elongated oval in outline, nearly three times as long as broad. The head is produced in front into a prominent but short, acute, median spine or rostrum, and the antero-lateral angles are also acutely produced, but are shorter and less acute than the rostrum. The eyes are prominent and black, situated on the upper surface of the head, near the lateral margins. They are elliptical in outline, with the long axes converging toward a point near to, or beyond, the tip of the rostrum. The basal segment of the antennulæ is shorter than the rostrum; the flagellum consists of about thirty segments and does not attain the tip of the fourth antennal segment. The scale on the second segment of the antennæ is short and triangular, does not surpass the following segment, and is tipped with a few slender setæ. The maxillipeds (pl. III, fig. 12 *a*) have the external lamella (*l*) obtusely pointed at the apex and angulated on the outer side, otherwise they resemble the same organs in *J. spinosa*, as do the outer maxillæ, the inner maxillæ, and the mandibles (pl. III, fig. 12 *b*).

The thoracic segments are but little broader than the head, the first three and the last two segments are about equal to each other in length; the fourth and the fifth are somewhat shorter. The lateral margins of the segments do not cover the epimera from above, and none of them are produced at the sides into acute and salient angulations, as in the next species. In the first segment the lateral margins are rounded and the epimera project as an angular tooth on each side in front. In the second, third, and fourth segments the emargination is behind a prominent but narrow lobe at the anterior angle of the segment and the epimera are two-lobed. In the fourth segment the posterior angle is nearly included in the emargination, and in the last three segments the posterior angle is elided and the epimera occupy its place. The legs are elongated and armed with spines, especially on the carpal segments.

The pleon is rounded-hexagonal in outline, minutely and sharply serrate at the sides behind the middle, and undulated over the bases of

the uropods on the posterior margin. The uropods are slender, easily detached, and liable to escape observation. They are nearly alike in the two sexes, and consist on each side of an elongate, somewhat curved and clavate basal segment, bearing at the end two rami, of which the inner is nearly as long as the basal segment, the outer somewhat smaller and shorter. The rami are slightly flattened, and, like the basal segment, armed with setæ, especially at the tip. The branchial pleopods are protected in the female by a subcircular operculum (pl. III, fig. 13 *a*). In the male, the inferior surface of the pleon (pl. III, fig. 13 *b*) presents on each side a nearly semicircular plate (*b*), with its inner margin overlapped by a median, elongated, and narrow plate (*c*), marked along the median line by a suture. This plate is broadest near the base, then contracts on each side to beyond the middle, after which it expands slightly. The median suture is open near the tip, and, on each side, is a rounded lobe, separated by a sinus from the produced external angle.

Length of body, exclusive of the antennæ and uropods, 8^{mm}, breadth 3^{mm}. Color in alcohol usually pale or brownish, with small black dots on the upper surface. The under surface is lighter, as are the legs and antennæ, especially toward their distal extremities.

This species is at once distinguished from the common European *J. maculosa* Leach by the form of the head, which is rostrate, and has also the antero-lateral angles strongly salient, while in *J. maculosa* the anterior margin of the head is nearly straight and the angles are not produced. From *Henopomus tricornis* Kröyer,* as described and figured by that author, it differs in the elongated uropods.

This species has not been found south of Cape Cod. Dr. Stimpson's specimens were "dredged in soft mud in 40 f. off Long Island, G. M.," in the Bay of Fundy. It was dredged in Massachusetts Bay! in from 54 to 115 fathoms mud, sand, and stones in 1878. In many localities given below in the Gulf of Maine! from 35 to 115 fathoms in 1873, 1874, and 1877, and 120 miles south of Halifax!, N. S., in 120 fathoms gravel and pebbles in 1877. It has also been obtained from several localities in the Bay of Fundy!, in one case at low water on Clark's Ledge, near Eastport, Me. A specimen was collected in 1879, by Mr. Charles Ruckley, of the schooner 'H. A. Duncan,' thirty miles east of the Northeast light on Sable Island, adhering to a specimen of *Paragorgia*, from a depth of 160 to 300 fathoms.

* Naturhist. Tidssk., II, B. ii, p. 380, 1847; Voy. en Scand., Crust., pl. xxx, figs. 2 *a-g*, "1849."

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
	Gulf of Maine, ESE. from Cape Ann 29-30 miles.	85	Mud, sand, stones	— —, 1878	U. S. Fish Com.	1	♀	Alc.
	Gulf of Maine, ESE. from Cape Ann 30-31 miles.	110-115	Mud, stones	— —, 1878	do	1	♀	Alc.
	Gulf of Maine, SE. $\frac{1}{2}$ S. from Cape Ann 6-7 miles.	54-60	Sand, mud	— —, 1878	do	2	♂ ♀	Alc.
1934	Gulf of Maine, SE. from Cape Ann 14 miles.	90	Soft mud	— —, 1877	do	1		Alc.
1923	Gulf of Maine, E. from Cape Ann 140 miles.	112-115	Sand and gravel.	— —, 1877	do	1	♂	Alc.
1935	Between Cape Ann and Isles of Shoals	35	Clay, sand, mud.	— —, 1874	do	1		Alc.
1924	Gulf of Maine, S. of Cashe's Ledge.	90	Rocky	— —, 1873	do			Alc.
1925	Casco Bay, Me.			— —, 1873	do	1		Alc.
	Banquereau			— —, 1878	Capt. Collins	1	♀	Alc.
1927	Bay of Fundy, Me.			— —, 1872	U. S. Fish Com.	3		Alc.
1928	Bay of Fundy, Clark's Ledge.	L. w. 30	Rocky	— —, 1872	do			Alc.
1929	Bay of Fundy, Buckman's Head.			— —, 1872	do			Alc.
1930	Bay of Fundy, off Todd's Head.			Aug. 27, 1872	do			Alc.
1932	Bay of Fundy, Eastport.			— —, 1870	A. E. Verrill	1		Alc.
	Thirty miles east of Northeast light on Sable Island.	160-300	On <i>Paragorgia</i> ..	— —, 1879	Mr. C. Ruckley.	1	♂	Dry.
1933	South of Halifax 120 miles.	190	Gravel and pebbles.	— —, 1877	U. S. Fish Com.	1		Alc.

***Janira spinosa* Harger.**

Janira spinosa Harger, Proc. U. S. Nat. Mus., 1879, vol. ii. p. 158, 1879.

This species is well marked among our known Isopoda, by the double row of spines along the back and the acute lacinations or angulations on the lateral margins of the thoracic segments.

The body is robust, the length but little exceeding twice the breadth. The head is broad, and produced in the median line into a prominent acute spine, or rostrum, about as long as the head. The antero-lateral angles are also produced and very acute, but do not extend as far as the rostrum. The eyes are rounded semi-oval, with the long axes converging toward a point near the base of the rostrum. The basal segment of the antennulæ is less than one-third the length of the rostrum. The second segment is about as long as the first, but of only about half its diameter. The flagellum equals, or slightly surpasses, the third antennal segment, and consists of about twelve segments. The scale, or spine, on the second segment of the antennæ is slender and considerably surpasses the third segment. The external lamella of the maxillipeds has the outer angle prominent, though not acute.

The thoracic segments are produced laterally into one or two acute angulations, giving a sharply serrated or dentated outline to the tho

racic region. The first segment is shorter than the second; the second, third, and fourth are about equal in length; the fifth is about the length of the first; the sixth and seventh each a little longer. The first segment is acutely produced at the sides, around the sides of the head, and bears, near the middle of the anterior margin, two short spines, situated about half as far apart as are the eyes, and directed upward and somewhat forward. The second segment has both lateral angles produced into triangular acute processes, of which the anterior is more slender than the posterior and directed more strongly forward. The dorsal spines on this segment are a little farther apart and larger than in the first segment. In the third segment the lateral angulations are more nearly equal than in the second segment and directed less strongly forward. In the specimen figured the third segment bears, on the left side, a single broad angulation, apparently representing the posterior, while the anterior is only indicated by a slight irregularity in the outline. Malformations of this kind appear to be common. The dorsal spines on the third segment are much as in the second. On the fourth segment the anterior angulation is longer than the posterior, and both are directed nearly outward. The dorsal spines on the fourth segment are slightly smaller and nearer together than on the third; but, as in all the preceding segments, they are near the anterior border of the segment. The last three segments are acutely produced at the sides into a single angulation, which is directed more and more backward to the last segment. The dorsal spines on the fifth segment are situated nearer together than on the anterior segments, and rather behind the middle of the segment; they are also smaller than on the preceding segments. On the last two segments they are near the posterior border of the segment, and become somewhat smaller and nearer together on the last segment. The legs are armed with but few, and rather weak, spines.

The pleon is broadest near the base and tapers posteriorly, where the angles are acutely produced; between these angles the margin is rounded and arched over the bases of the uropods, which are about as long as the pleon and less spiny than in *J. alta*. The lateral margin of the pleon is armed with very minute acute spinules, and under a higher power the margins of the thoracic segments and of the head are seen to be similarly armed, especially where most exposed.

Length 8^{mm}, breadth 3.8^{mm}; color in alcohol, white.

This species is near *Janira laciniata* G. O. Sars,* but is distinguished by the double row of dorsal spines, whereas Sars says of that species, "Superficies dorsalis medio leviter convexa spinis singulis tenuibus ornata."

The only specimens yet known are two females, which were taken adhering to the cable of the schooner 'Marion', by Captain J. W. Collins, at Banquereau, August 25, 1878.

* Chr. Vid. Selsk., 1872, p. 92, 1873.

Munna Kröyer.

Munna Kröyer, Naturhist. Tidssk., B. ii, p. 615, 1839.

Form of the female dilated oval, of the male elongated sublinear; head very broad (about twice as broad as long), in length equal to one-fourth or one-fifth the length of the animal; eyes occupying the postero-lateral angles of the head, prominent, as if pedunculated but not movable; antennulæ inserted above the antennæ and partly covering their bases, short, a little longer than the head, with a four-jointed peduncle and a few-jointed flagellum; antennæ elongated, equaling or surpassing the length of the body, with a multiarticulate flagellum; mandibles with a three-jointed palpus; maxillipeds with a five-jointed palpus; legs all armed with two terminal ungues; first pair shorter and more robust than the others, with a prehensile hand formed of the propodus and the dactylus; the remaining pairs ambulatory, increasing gradually in length, so that the last pair equal or surpass the body in length. The segments of the pleon are united into a single vaulted segment, and its inferior surface is covered, in the females, by a single opercular plate, while in the males the operculum is composed of three parts, as in the preceding genera.

The generic description as given above is in part taken from Kröyer, the author of the genus. The specimens hitherto obtained do not appear to be separable from his species *M. Fabricii*, to which I have therefore referred them, although differing somewhat from each other. The material has unfortunately been, most of it, in poor condition, many of the specimens having been dried and much broken.

Munna Fabricii Kröyer.

Munna Fabricii Kröyer, Nat. Hist. Tidssk., II, B. ii, p. 380, 1847; Voy. en Scand., Crust., pl. xxxi, figs. 1 a-q. "1849".

Reinhardt, Grönlands Krebsdyr., p. 35, 1857.

M. Sars, Christ. Vid. Selsk. Forh., 1858, p. 154, 1859.

Lütken, Greenland Crust., p. 150, 1875.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 159, 1879.

Munna, species, Verrill, Am. Jour. Sci., III, vol. vii, p. 133, 1874; Proc. Am. Assoc., 1873, p. 371, 1874.

? *Munna Bæckii* G. O. Sars, Arch. Math. Nat., B. ii, p. 353 [253], 1877. (*M. Bæckii* Kröyer?)

PLATE III, FIG. 14.

This species may be at once distinguished from anything else known on our coast by the prominent, as if pedunculated, but immovable, eyes, on the posterior lateral angles of the large head, together with the elongated and slender ambulatory legs in seven pairs, the first pair only being somewhat shorter.

The first specimens obtained in a recognizable condition were small and differed somewhat from later specimens, especially in size and proportions; the differences, however, do not appear to be necessarily other than what might be due to age and size, and are such as are described

by Kröyer in his specimens of *M. Fabricii*. The legs in the small specimens figured are considerably shorter than in larger specimens obtained in 1878, and the flagellum of the antennulæ consists in the small specimens of a single segment, or with traces of subdivision into two, while in the large specimens it is four-jointed, with a rudimentary terminal segment.

The body is in the female elongate oval, tapering posteriorly, and broadest at the third thoracic segment, where the breadth is equal to about half the length. The males are more slender, and are not dilated behind the head. The head forms about one-fifth of the total length, and is nearly twice as broad as long. Its anterior portion between the bases of the antennulæ and antennæ is comparatively narrow on its upper surface, and is rounded or obtusely angled in front. Behind the bases of the antennulæ it is suddenly much dilated at the sides, and a little behind the dilation are the prominent, strongly convex and laterally projecting eyes, immediately behind which the head contracts suddenly in width, and is then slightly rounded behind. The antennulæ arise in a deep sinus on the antero-lateral region of the head. They consist of a four-jointed peduncle followed by a four-jointed flagellum of about the same length as the peduncle. The basal antennular segment is stout, and subtrigonal in form; the second is more slender and cylindrical, while the third and fourth are subequal, quite short and small, together not over half as long as the second segment, and should perhaps rather be regarded as flagellar segments. The four flagellar segments are of a little less diameter than the last two peduncular segments, and are long and cylindrical, the fourth being tipped with a rudimentary segment bearing two strong terminal setæ. The antennæ are much larger and stouter than the antennulæ and are about two or three times as long as the body. They are composed of a five-jointed peduncle and a slender multiarticulate flagellum. They arise nearly in front of the antennulæ and their first three segments are short and stout, not longer taken together than the first two antennular segments. The fourth segment of the antennæ is only about half the diameter of the first three segments, but is greatly elongated, nearly or quite equaling in length the head and thorax taken together, and is cylindrical, and provided with a few short setæ, especially at the tip. The fifth, or last peduncular, segment is slightly more slender and elongated than the fourth, and is followed by a slender tapering flagellum composed of about seventy-five segments, or, perhaps, in perfect specimens, of a greater number. The maxillipeds are large and broad, as required by the large head, and are furnished with a five-jointed palpus, with the basal segment short, the second and third flattened and expanded internally, where they are also ciliated; the fourth narrow; the fifth short, and both provided with scattered setæ, especially toward the tip.

The first thoracic segment is a little shorter than the second, which is about equal in length to the third and the fourth; the last three seg-

ments progressively decrease in length and width, and the seventh is somewhat concealed at the sides by the swollen base of the pleon. The basal segments of all the legs are much alike in form, and differ but little in size throughout. They are cylindrical or slightly clavate, the first pair perceptibly shorter and smaller than the second, from which they increase very slightly to the sixth, which is the largest, the seventh not being larger than the second. The legs disarticulate easily at the end of the basal segment, and in the specimens examined nearly all are broken off at this point. Beyond the basal segment the first pair are comparatively short, about half the length of the body. The ischium of the first pair is robust, and a little longer than the merus; the carpus is subtriangular and armed with strong short spines on its palmar margin; the propodus is about as long as the ischium, slightly swollen, and armed with a few spines; the dactylus is short and armed at the end with two stout curved claws, of which the outer is about twice the length of the inner; between the claws is a slender bristle. The second and following pairs of legs are much more elongated than the first pair, the elongation being principally in the carpus and propodus, and, in a less degree, in the ischium and merus, while the dactylus is comparatively but little elongated. In the second pair of legs the propodus is not longer than the carpus, but it becomes proportionally, as well as absolutely, longer in the following pairs until, in the sixth pair, it may be nearly or quite as long as the body and form about two-fifths the whole length of the leg. The dactyli are, in all the legs, comparatively short, often less than one-tenth the length of the propodus, and armed with two unequal claws, of which the longer is about two-thirds as long as the dactylus itself, and the shorter is more than half the length of the longer. In all the legs the ischium is armed with a few short curved spinules, and the elongated propodal segments are furnished with scattered, slender and elongated, straight spines, each with a minute bristle near the apex.

The pleon is remarkably swollen near the base, and is somewhat pear-shaped; posteriorly it is deep, and bears the uniarticulate uropods in shallow grooves near the end. On the upper surface are a few straight slender spines, and below it is covered in the females by an ovate, obtusely-pointed opercular plate, and in the males by a trifid operculum, the median portion being slender, with nearly parallel sides and a central suture, and the two lateral portions slender, semi-ovate and pointed behind. The pleon appears to be carried habitually, during life, flexed upward at a considerable angle.

The length of the specimen figured, by Mr. Emerton (pl. III, fig. 14), is 1.2^{mm}, breadth 0.7^{mm}; but specimens obtained in 1878 measure 3.1^{mm} in length, 1.5^{mm} in width, in the female, and 1.1^{mm} in the male. The pleon measures in length 1.1^{mm} and in width 0.8^{mm} in the larger individuals.

A single much mutilated specimen of this species was dredged in 12 fathoms, South Bay, Eastport!, in 1872, by the United States Fish Com-

mission, and two more specimens, both females, were obtained on eel-grass in Casco Bay! in 1873. Five specimens were obtained adhering to dried specimens of *Acanella* from 150 fathoms, Western Bank!, in 1878, and a sixth, in 53 fathoms, on Brown's Bank!, in lat. 42° 50' N., lon. 65° 10' E., by Captain J. Q. Getchell, of the schooner 'Otis P. Lord,' in the same year. In 1879 a specimen was obtained adhering to *Acanthogorgia armata*, by Captain George A. Johnson and crew of the schooner 'Augusta H. Johnson,' on Western Bank!, in lat. 43° 15' N., lon. 50° 20' E., 200 fathoms. These specimens were, as has been mentioned, considerably larger than those at first obtained. Kröyer's specimens were from a depth of 50 fathoms, at Godthaab, Southern Greenland, and according to M. Sars the species is abundant on the coast of Finmark among Hydroids in the coralline zone. G. O. Sars records *M. Bæckii* Kröyer, which he regards as scarcely differing from this species, at the harbor of Reikjavik, Iceland.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
2144	Casco Bay, Me.....	.....	Eel-grass	— —, 1873	U. S. Fish Com.	2	♀	Alc.
1936	Bay of Fundy, Me ..	12	.....	— —, 1872	do	1	♀	Alc.
	Brown's Bank	53	.....	— —, 1878	Capt. J. Q. Getchell.	1	♀	Dry.
	Western Bank	150	On <i>Acanella</i>	— —, 1878	.....	5	♂ ♀	Dry.
	Western Bank	200	On <i>Acanthogorgia armata</i> .	— —, 1879	Capt. G. A. Johnson.	1	♀	Dry.

IV.—MUNNOPSIDÆ.

In this family the body consists of two more or less distinct divisions, the first consisting of the head and anterior four thoracic segments, and the second of the last three thoracic segments, and the pleon, which is consolidated into a single segment, convex above. The eyes are wanting. The antennulæ are much shorter and smaller than the antennæ, and have their basal segment lamelliform. The antennæ are much elongated, with a five-jointed peduncle, of which the first three segments are short and the last two elongated and tipped with a long multi-articulate flagellum. The maxillipeds have their basal segments flattened and operculiform, covering the other mouth parts, and furnished with a large external lamella and a five-jointed palpus. The first pair of legs are shorter than the three following pairs and imperfectly prehensile. The next three pairs are ambulatory and usually greatly elongated. The last three pairs of legs, or at least the fifth and sixth pairs, are different in form from the preceding, and fitted for swimming, with some of the distal segments flattened and provided with marginal cilia

or spines. The pleopods are protected by a thickened opercular plate, and the uropods are short and simple or biramous. The incubatory pouch in the females is beneath the first four thoracic segments.

Of this family, two species have been found on the New England coast, and a third, from the Gulf of St. Lawrence, is here included. The specimens obtained have been mostly in poor condition, and one of these, belonging apparently to an undescribed species, is so imperfect that I have decided to await the collection of better specimens before attempting a specific description. In the family characters given above, as well as in the following generic and specific descriptions, I have availed myself largely of the admirable works of M. Sars and his son G. O. Sars, the distinguished Norwegian naturalists, to whom science is indebted for the discovery and characterization of the present group.

The *Munnopsidæ* of our coast may be easily recognized as belonging to the family by the structure of the last three pairs of thoracic legs, which are fitted for swimming by being more or less flattened and ciliated; the last pair, however, may return to the more normal type of leg, so that the fifth and sixth pairs only may be natatory. The three genera which appear to be represented are distinguished as follows: Body suddenly constricted and slender behind the fourth thoracic segment in *Munnopsis* (p. 329); pretty regularly oval in form, with three pairs of flattened natatory legs in *Eurycope* (p. 38); suboval but deeply incised behind the fourth segment, in *Ilyarachna* (p. 40), in which genus the last pair of legs are scarcely at all flattened or ciliated.

***Munnopsis* M. Sars.**

Munnopsis M. Sars, Christ. Vid. Selsk. Forh., 1860, p. 84, 1861; Christ-fjord Fauna, p. 70, 1868.

Anterior division of the body dilated, posterior suddenly much narrower and linear. Antennulæ with the basal segment large and flattened, the flagellum elongate and multiarticulate; antennæ very long and slender, many times longer than the body; the last two peduncular segments greatly elongated; the flagellum about equal in length to the peduncle; mandibles subtriangular, entire and acuminate at the apex, without a molar process; the palpus slender with the last segment thick at the base and curved in the form of a hook; penultimate segment of the maxilliped not dilated inwardly; last segment very narrow and linear. Four anterior thoracic segments excavated above, obtusely rounded at the sides; the three following subcylindrical with short acuminate lateral processes; first four pairs of thoracic legs six-jointed (beyond the coxal segment), the first pair short; the second pair not much longer, rather robust and subprehensile in the males; the two following pairs greatly elongated and very slender, many times longer than the body; but with the basis, ischium, and merus very short; last three pairs of legs natatory, all alike, six-jointed, being destitute of dactyli, with the last two segments, the carpus and propodus, foliaceous, margined with long, slender, delicately plumose setæ. Pleon elongate, much

longer than broad; abdominal operculum large (nearly covering the whole under surface of the pleon), suboval, simple in the female, but consisting of three distinct segments in the male, one median and very slender, and two lateral, and furnished within with a peculiar curved organ, terminated behind with a much elongated seta; uropods slender uniramous.

Munnopsis typica M. Sars.

Munnopsis typica M. Sars, Chr. Vid. Selsk. Forh., 1860, p. 84, 1861; Christ. Fjord. Fauna, p. (70), pl. vi-vii, figs. 101-138, 1868; Chr. Vid. Selsk. Forh., 1868, p. 261, 1869.

G. O. Sars, Chr. Vid. Selsk. Forh., 1863, p. 206, 1864; Reise ved Kyst. af Christ., p. (5), 1866; Christ. Fjord Dybvands-fauna, p. (44), 1869; Chr. Vid. Selsk. Forh., 1872, p. 79, 1873; Arch. Math. Nat., B. ii, p. 353 [253], 1877.

Whiteaves, Ann. Mag. Nat. Hist., IV, vol. x, p. 347, 1872; Deep-sea Dredging, Gulf of St. Lawrence (1872), pp. 6, 15, 1873; Am. Jour. Sci., III, vol. vii, p. 213, 1874; Further Deep-sea Dredging, Gulf of St. Lawrence (1873), p. 15, 1874.

Buchholz, Zweite Deutsche Nordpolfahrt, Crust., p. 285, 1874.

Heller, Denksch. Acad. Wiss. Wien, B. xxxv, p. (14) 38, 1875.

Norman, Proc. Royal Soc., vol. xxv, p. 208, 1876.

Miers, Ann. Mag. Nat. Hist., IV, vol. xx, p. 65, 1877.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 159, 1879.

PLATE II, FIG. 11.

This species is easily recognized among the known Isopoda of our coast by the form of the body, which suddenly diminishes in diameter behind the fourth thoracic segment, so that the last three thoracic segments, bearing the ciliated, swimming legs, are only about half as broad as the anterior part of the body.

Anterior division of the body depressed, posterior subcylindrical; breadth of body less than half the length. Head small, with the length and breadth about equal, equaling the two anterior thoracic segments in length, but of much less breadth, truncate in front and without a rostrum, bearing near the posterior dorsal margin two minute conical tubercles. The eyes are wanting. The antennule in the female, when reflexed, extend to the third thoracic segment, in the male to the fourth, with the flagellum longer than the peduncle, pectinate or furnished with a longitudinal series of long setæ, multiarticulate; segments in the female, 23 to 28; in the male, 65 to 66. The antennæ are greatly elongate, about five times as long as the body, very slender; peduncle more than twice the length of the body, the last two peduncular segments beset with numerous short spinules, arranged in longitudinal rows; flagellum nearly as long as the peduncle, composed of about 130 segments. The external lamella (*l*) of the maxillipeds (pl. II, fig. 11 *b*) is narrowed in front with the external margin convex.

The four anterior thoracic segments are subequal, short, about five times broader than long; last three segments broader than long, less than

half the width of the preceding segments, bearing near the anterior dorsal margin two small conical tubercles; pleon slightly longer than the three preceding segments together, but not narrower, forming somewhat more than one-fourth the length of the body, elongate-suboval, the breadth scarcely equaling half the length, with a median, rounded, dorsal crest, but little elevated, and bearing in front of this near the anterior margin a small conical tubercle.

Propodus shorter than the carpus in the first pair of legs, equal to it in length in the second pair, which in the males (pl. II, fig. 11 *e*) have the carpus thickened, and armed, on the inferior margin, with stronger spines than in the females; third and fourth pairs of legs about thrice the length of the body, with the three basal segments, basis, ischium, and merus, very short and robust; the last three very much elongated and filiform; the propodus longer than the carpus, both armed with many short spinules arranged longitudinally; dactylus about one-fifth as long as the propodus, slightly curved, naked, very minutely serrulate along the convex margin. Last three legs (pl. II, fig. 11 *f*) with the carpus and propodus elongate-subelliptic, both segments strongly ciliated, the propodus a little shorter than the carpus.

Abdominal operculum in the female (pl. II, fig. 11 *g*) with a longitudinal, elevated, acute median crest, flattened medially in the males. Uropods slightly more than one-third the length of the pleon, composed of two subequal segments. Laminæ of the incubatory pouch in the females attached to the anterior four thoracic segments; the three posterior pairs large; the third and fourth suborbicular; the second elongate; the first much smaller, bifid at the apex.

Length 8–10^{mm}; antennæ 40–50^{mm}; third and fourth pairs of legs 24–30^{mm}. Color, light yellowish, or grayish, in alcohol; lighter below.

The specimens that I have had an opportunity of examining were all more or less imperfect, and I have therefore, in both the generic and specific descriptions given above, made free use of the admirable and exhaustive description of this genus and species by M. Sars,* and the figures of the species on plate II were copied from the same author, having been drawn by his not less distinguished son, G. O. Sars.

This species like its allies is an inhabitant of deep water on muddy bottoms. Three specimens, the only ones that I have personally examined, were taken by the Fish Commission in the Bay of Fundy! between Head Harbor and the Wolves, in 60 fathoms muddy bottom, August 16, 1872. It has been dredged by Mr. Whiteaves in the Gulf of St. Lawrence in 125 to 220 fathoms; by the Valorous Expedition in Baffin Bay in 100 fathoms (Norman); in 25 to 50 fathoms off Cape Napoleon, Grinnell Land, by the Arctic Expedition (Miers); between Norway and Iceland in from 220 to 417 fathoms; Christiania fiord, 200 to 230 fathoms (G. O. Sars); Christiania Sound 50 to 60 fathoms,

* Bidrag til Kundskab om Christiania-fjordens Fauna, 1868, pp. 70–95, pls. vi–vii. (Nyt Magazin.)

whence the species was described by M. Sars; off Storeggen, 400 fathoms (G. O. Sars), and northward among the Loffoden Islands, 250 fathoms; the coast of Finmark, Spitzbergen (Buchholz), and the Arctic Ocean about Nova Zembla (G. O. Sars.)

Eurycope G. O. Sars.

Eurycope G. O. Sars, Chr. Vid. Selsk. Forh., 1863, p. 208, 1864.

Body depressed, subovate as seen from above; about equally attenuated before and behind. Head of medium size, more or less produced between the antennulæ; antennæ very slender, two to four times as long as the body; flagellum longer than the peduncle; mandibles robust, quadridentate at the apex, and bearing below a series of rigid setæ and a strong molar process; mandibular palpus well developed, with the terminal segment enlarged at its base and curved. Four anterior thoracic segments subequal, short; three posterior segments large not suddenly narrower than the anterior segments; the first pair of legs shorter than the next three, with the dactylus short; the next three pairs elongated, and with elongated and slender dactyli; three posterior pairs of legs distinctly natatory, with the carpus and propodus strongly flattened and provided with numerous plumose marginal setæ; dactylus of the ordinary form. Pleon rather large, broader than long, obtusely rounded behind; operculum subpentagonal with rounded angles, much smaller than the pleon. Uropods short, biramous, rami uniarticulate. Dorsal surface of the body smooth and shining.

For the characterization of the genus, as given above, I have depended largely upon the work of G. O. Sars, having had myself, for examination, only the following species:

***Eurycope robusta* Harger.**

Eurycope robusta Harger, Am. Jour. Sci., III, vol. xv, p. 375, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 159, 1879.

PLATE III, FIG. 15.

This species may be recognized by the flattened and ciliated swimming legs, in three pairs, on the last three thoracic segments, which are not, as in the preceding species, suddenly of much less diameter than the anterior four segments.

Body oval with the length equal to, or slightly exceeding, twice the breadth. Head, behind the bases of the antennulæ, longer than the first thoracic segment, produced medially into a short rostrum about half as long as the basal antennular segment. Antennulæ (pl. III, fig. 15 *a*) attaining the middle of the fourth segment of the antennæ in the females, surpassing the middle of this segment in the males; basal segment subquadrate, spinulose at the distal angles, somewhat narrowed from the base, bearing the second much smaller segment a little beyond the middle

of its superior surface; third segment longer and more slender than the second; flagellum of more than twenty articulations, which become indistinct near the base, and are furnished with terminal setæ. Antennæ about thrice the length of the body in the female, somewhat shorter in the male, the sexes differing in the fourth and fifth segments, which, in the females, are subequal in length and, together, as long as the body, while in the male the fifth is shorter than the fourth, and the two segments together are about two-thirds as long as the body. The flagellum is long, slender, and multiarticulate. Maxillipeds (pl. III, fig. 15 *b*) with the external lamella sub-rhombic, emarginate on the exterior distal side; palpus five-jointed, first segment short, produced externally into a very acute angle; second and third segments broad and flattened; fourth narrow with the inner angle produced and rounded; fifth short, oval. Maxillæ of the ordinary form, outer pair with slender lobes. Mandibular palpus elongated, last segment strongly curved.

Thorax widest at the fourth segment; first four segments forming about one-third its length on the median line, last segment longest, all with their antero-lateral angles produced, the anterior four with the epimera projecting as an acute process below, and in front of, the angle. First pair of legs (pl. III, fig. 15 *d* and *d'*) about three-fourths the length of the body; dactylus short; propodus shorter than the carpus; slightly hairy, especially on the propodus with slender hairs. Next three pairs of legs longer than the body, subequal, but increasing a little in length to the fourth; dactyli slender and acicular; propodi and carpi subequal, spinulose along their inner margins in the second pair, but not in the third and fourth. Last three pairs of legs with the carpus strongly dilated and flattened, subcircular as seen in pl. III, fig. 15 *f*, where the sixth pair is represented; propodus also much flattened and dilated; both segments strongly ciliated with plumose bristles, as is also the ischium, or second segment along the outer dilated margin; dactylus about half the length of the propodus instead of less than one-third its length, as in *E. cornuta* G. O. Sars, the species most resembling the present.

Pleon much broader than long, broadly rounded behind. Operculum also broader than long, strongly roof-shaped. Uropods (pl. III, fig. 15 *g*) with the basal segment shorter than the rami, which are uniarticulate, cylindrical, of equal length, obtuse and tipped with a coronet of short spines. The inner ramus is more robust, but not longer than, the outer.

Color in alcohol, honey yellow; length 4.5^{mm}; breadth 2.2^{mm}.

This species appears to approach *E. cornuta* G. O. Sars,* but may be readily distinguished by its greater size, by the shortness of the rostrum, the equal rami of the uropods, and the shape of the external lamella of the maxillipeds, which he describes in that species as "versus apicem dilatata et emarginata utrinque acute producta." In the third and fourth pairs of legs, moreover, the carpus and propodus are not armed with spines as in that species according to Sars' description.

* Chr. Vid. Selsk. Forh., 1863, p. 209, 1864.

This species was dredged by Mr. J. F. Whiteaves in the Gulf of St. Lawrence! at a depth of 220 fathoms muddy bottom, and has not yet been found on the coast of New England. It is introduced here from the probability that it will yet be discovered in the deeper parts of the Bay of Fundy, where the allied *Munnopsis typica* M. Sars has already been found, or even in the Gulf of Maine.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1938	Gulf of St. Lawrence	220	Mud .....	.....	J. F. Whiteaves	10	♂ ♀	Alc.
1939	Gulf of St. Lawrence	220	...do .....	.....	...do	3	.....	Alc.

Ilyarachna G. O. Sars.

Mesostenus G. O. Sars, Chr. Vid. Selsk. Forh., 1863, p. 211, 1864.

Ilyarachna G. O. Sars, Christ. Fjord. Dybvands-fauna, p. (44), 1869.

Body scarcely depressed, subpyriform as seen from above, narrowed behind; its anterior division separated from the posterior by a deep constriction. The head is large and broad and without a rostrum. Antennulæ short, with a flagellum composed of but few segments. Antennæ exceeding the body in length, with a multiarticulate flagellum. Mandibles short and strong, entire at the apex; molar process armed with a few setiform spines; palpus either small and three-jointed or wanting. Four anterior thoracic segments short, excavated above and furnished with lateral processes directed forward; the three following convex above and destitute of lateral processes; the antepenultimate scarcely narrower than the anterior segments and deeply emarginate behind. First pair of legs nearly as in the preceding genus; second pair unlike the others and usually more robust; the following two subequal and commonly much elongated; fifth and sixth pairs of legs much as in *Eurycope*; the last pair unlike the preceding, long and slender, with the segments scarcely flattened, and armed with a long curved claw. Pleon narrowly triangular, pointed at the apex. Abdominal operculum large, covering nearly the whole of the under surface of the pleon, provided with a median crest and numerous marginal setæ. Uropods simple, appressed to the pleon.

For the generic description given above I have depended almost entirely upon the work of Dr. G. O. Sars, who originally described the genus under the name *Mesostenus*. That name being preoccupied he subsequently changed it to *Ilyarachna*.

Ilyarachna species.

A single imperfect specimen of a species apparently belonging to this genus was dredged in 106 fathoms, gray mud, 21 miles east of Cape Cod Light!, September 18, 1879. The species is probably yet undescribed, but, in view of the very imperfect condition of the only specimen yet known, I have decided to await the collection of better specimens before attempting to make out its characters. It may yet be found to represent an undescribed genus, but I am at present inclined to regard it as a species of *Ilyarachna*.

V.—IDOTEIDÆ.

Antennulæ consisting of four segments, of which the basal is more or less enlarged and the terminal clavate; mandibles not palpigerous; thoracic segments subequal in length; pleon with more or fewer of its segments consolidated into a large, scutiform, terminal piece; uropods inferior, transformed into a two-valved operculum protecting the pleopods.

The *Idoteidæ* are represented on the New England coast by ten species; another, found near our northern limits, is included, making eleven in all, belonging to five genera. The family may be further characterized, so far as regards our species, as follows: The body is depressed, and varies in its proportions of length to breadth from about two to one in *Chiridotea cæca* to nearly six to one in *Erichsonia attenuata*. The head is quadrate in outline, except in *Chiridotea*. The eyes are present and usually lateral, but may not be conspicuous. The antennulæ are four-jointed and similar in form throughout the family; they may or may not surpass the head in length, but are usually short and small. The basal segment of the antennulæ is more or less enlarged and usually subquadrate; the second segment is clavate; the third longer and less distinctly clavate; the fourth, or terminal, segment, corresponding with the flagellum of the antennulæ, is nearly straight along its outer, or in the natural position posterior, margin, while the opposite margin is gently curved from near the base, and rounds over more sharply at the tip; along this margin, especially toward the tip, are tufts of short setæ at regular intervals, indicating an approach toward segmentation. The antennæ have a five-jointed peduncle, varying little in form throughout the family; the first of these segments is short; the second is much larger and deeply notched on its under side; the third, fourth, and fifth segments are longer, but more slender and cylindrical or somewhat clavate. The flagellum of the antennæ may be articulated with many or few segments; it may consist of a single segment, or may be rudimentary. The maxillipeds are operculiform and cover the other parts of the mouth below. They consist, on each side, of a large semi-oval plate, with a straight interior margin, meeting its fellow

of the opposite side, and bearing on this margin a short, curved, styli-form organ. They are provided at the tip with stout pectinate setæ, and along the basal portion of the outer margin lies, on each side, the large external lamella. The palpi of the maxillipeds are flattened and ciliated along their inner margins, and the number of segments may be reduced to three by the coalescence of the last two and of the preceding two. The maxillæ vary but little in the family; the second or outer pair bear as usual three delicate ciliated plates; the first or inner pair are armed with stouter setæ and spines. The mandibles are robust, acutely toothed at the apex, armed with a more or less powerful molar process, and are destitute of palpi.

The thoracic segments are distinct and subequal in length, but may differ considerably in width, and are not united with the head nor with the pleon. The legs, except in the genus *Chiridotea*, are nearly similar in form throughout, and, in the first three pairs at least, are terminated by a prehensile or subprehensile hand, formed by the more or less complete flexion of the dactylus upon the propodus. The first pair of legs is usually shortest and has a triangular carpus. The anterior three pairs of legs are, in general, directed forward, and the posterior four pairs are directed backward and are less perfectly, or not at all, prehensile, a distinction that reaches its highest development in *Chiridotea*. The seventh pair of legs are absent in the young taken from the incubatory pouch, and do not generally attain quite as large size as the sixth pair.

The pleon, seen from above, consists in great part, or entirely, of a large, convex, usually pointed, scutiform piece, representing the consolidated terminal segments. As many as four of the anterior segments may, however, be more or less completely separated by articulations or indicated by lateral incisions or sutural lines. Underneath, the pleon is provided with a structure peculiar to and characteristic of this family, and the next, viz, a two-valved operculum, formed by the specially modified uropods,* or appendages of the terminal segment, closing like a pair of cupboard doors and protecting the delicate pleopods, which are lodged in a vaulted chamber excavated in the under surface of the pleon. This operculum consists, on each side, of an elongated basal plate, often strongly vaulted, angulated externally near the base, where it is articulated with the terminal segment of the pleon, and bearing at the tip one, or sometimes two, small lamellæ. One of these lamellæ usually disappears, but two are present in *Chiridotea*, as also in the foreign genera *Cleantis* and *Chaetilia*. When both are present the opercular plates differ only in proportion from the ordinary form of uropods, consisting of a basal segment and two rami. Within the cavity enclosed by the opercular plates lie the usual five pairs of pleopods, each consisting of a basal segment

* In the last edition of the Encyclopædia Britannica (vol. vi, p. 641), these organs are described as the "anterior" abdominal appendages. They are anterior only in position, being in fact the appendages of the posterior segment.

supporting two lamellæ, and two or more of the anterior pairs are ciliated with fine plumose hairs. The inner lamella of the second pair of pleopods bears, in the adult males, a slender style articulated near the base of the inner margin and varying in length and structure in the different genera and species. The pleopods, besides their branchial office, are also of importance in locomotion, being used for swimming, which is a frequent mode of progression in this family, and is often performed with the back downward.

The females are usually broader than the males and carry their eggs and young in a pouch, on the under surface of the thorax, formed of four pairs of plates, attached to the coxal segments of the second, third, fourth, and fifth pairs of legs, and overlapping along the median line.

The known Isopoda of this family on the coast may be most easily recognized by the presence, underneath the pleon, of a two-valved operculum, opening like a pair of cupboard doors, and by the first three pairs of legs being more or less prehensile. Our genera may be distinguished by means of the following table:

Flagellum of the antennæ	{ articulated; legs	{ dissimilar, last four pairs not prehensile.....	CHIRIDOTEÆ, p. 337
		{ alike, prehensile; epimera.....	{ evident above IDOTEÆ, p. 341 not evident above..... SYNIDOTEÆ, p. 350
	{ not articulated, clavate		ERICHSONIÆ, p. 354
	{ short and rudimentary		EPELYS, p. 357

Chiridotea Harger.

Chiridotea Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.

First three pairs of legs terminated by prehensile hands, in each of which the carpus is short and triangular, the propodus is robust and the dactylus is capable of complete flexion on the propodus; antennæ with an articulated flagellum; head dilated laterally; abdominal operculum vaulted, with two apical plates.

The two species of this genus found on our coast agree further in the following particulars: The body is short, the length being only about twice the breadth, and the outline of the head and thorax together is subcircular. The anterior part of the lateral margin of the head is produced and deeply lobed, the eyes thus appearing dorsal instead of lateral; posteriorly the head is deeply received into the first thoracic segment. The antennulæ are proportionally large, equaling or surpassing the peduncle of the antennæ. The external lamella of the maxillipeds (see pl. IV, figs. 18 and 21) is large and broad and the palpus consists of only three segments, of which, however, the last two are each composed of two coalesced segments, that are separate in the European *Ch. entomon*. Of the two segments thus formed, the terminal is quadrate or rhomboid in outline, with rounded angles and is smaller than the preceding, which expands distally toward the articulation between the two.

The thorax is deeply excavated, in front for the head and behind for the abdomen, so that the thoracic segments are much longer at the sides than along the back, when measured parallel with the axis of the animal. The

epimera are separated by sutures, except in the first segment, and have their posterior angles acute. The first three pairs of legs have the dactylus capable of complete flexion upon the propodus, which is more or less swollen and supported by the short triangular carpus. In the last four pairs of legs the three corresponding segments are nearly cylindrical and the dactylus is incapable of complete flexion on the propodus.

The pleon, or abdomen, is convex throughout and pointed at the tip, and is composed, apparently, of five segments, of which the first three are separated by complete sutures, but the last two are united in the dorsal region, the sutures separating them being visible only at the sides. The opercular plates consist, on each side, of an elongated, vaulted, and attenuated plate, regularly rounded at the anterior end, truncate at the apex, and bearing just within the apex, on the inner side of the organ when closed, two ciliated, ovate or triangular plates. Of these the internal plate, or the one next the median line is much smaller than the outer; the outer also overlaps the inner, a disposition similar to that which prevails in the branchial plates or pleopods. The basal plate of the operculum is ciliated along its anterior and inner margin with bristles, which are plumose except in the region nearly opposite the articulation of the plate, where they become stouter and spine-like. The stylet on the second pair of pleopods in the males is long and slender, more than twice the length of the lamella to which it is attached.

Chiridotea cæca Harger (Say).

Idotea cæca Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 424, 1818.

Hitchcock, Rep. Geol. Mass., p. 564, 1833. (*I. cæca*?)

Gould, Rep. Geol. Mass., 2d ed., p. 549, 1835; Invert. Mass., p. 337, 1841.

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Verrill, This Report, part i, p. 340 (46), 1874.

Harger, This Report, part i, p. 569 (275); pl. v, fig. 22, 1874.

Chiridotea cæca Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878; Proc. U.S. Nat. Mus., 1879, vol. ii, p. 159, 1879.

PLATE IV, FIGS. 16-19.

This species is at once distinguished from the following by its larger size and short antennæ, which surpass the antennulæ but little, if at all. Among the other known Isopoda of the New England coast, it may be recognized by the broad, subcircular thorax, joined with an articulated flagellum of the antennæ and a two-valved abdominal operculum. The eyes are, moreover, light-colored and inconspicuous, whence the name.

The head is but slightly excavated in front for the bases of the antennæ, and there is a more or less open notch at the sides extending nearly to the eyes. The antennulæ (pl. IV, fig. 17 *a*) are longer than the peduncle of the antennæ and have the second segment strongly clavate; the third cylindrical; the last with about a dozen tufts of short

setæ; the peduncular segments are bristly, as are also those of the antennæ. The first segment of the antennæ (pl. IV, fig. 17 *b*) is very short, the second about three times as long, longer than any of the following segments; the third is longer and more slender than the fourth, which is nearly as broad as long; the fifth, or last peduncular, segment is more slender than any of the preceding, slightly clavate, about twice as long as broad, and longer than any except the second. The flagellum slightly exceeds the last two peduncular segments in length and consists usually of about seven segments, each bearing a tuft of short hairs near its extremity, except the first, which is much the longest, bears two such tufts, and is, apparently, composed of two segments united.

The breadth of the thorax is greater than its length along the median line. The first pair of legs (pl. IV, fig. 18 *b*) are a little shorter than the next two pairs, and the propodus or penultimate segment is a little more swollen. The carpus becomes slightly more elongated in the next two pairs. The last four pairs of legs are alike in form and increase in size to the sixth pair, which is the largest. The legs are bristly hairy, especially on the ischial, meral, and carpal segments, where they are provided with stout setæ curved at the tip. The basal segments bear longer and more slender plumose hairs. The epimera are ciliated on their external margins as are the lateral borders of the head and first thoracic segment and the tip of the pleon.

The operculum (pl. IV, fig. 18 *c*) is also ciliated with very fine hairs along its postero-external margin; the larger of the apical plates is broader than in the following species, the width being to the length as 6 to 10. The stylet on the second pair of pleopods in the male (pl. IV, fig. 19 *b*) considerably surpasses the cilia and is curved and acute at the tip. Adult males and females seem to be comparatively rare, and a common form of the second pair of pleopods (pl. IV, fig. 19 *a*) presents an acute stylet, imperfectly separated from the lamella and but slightly surpassing it in length, strongly ciliated like the lamella on its margin.

Length 12–15^{mm}; breadth 6–8^{mm}. The color in life is variable but usually dark grayish, much like the wet sand in or on which it is commonly found. It may be more particularly described as usually of a dark leaden gray on the top of the thorax, sometimes with a central spot, which may be bright pea-green, probably from the contents of the digestive cavity showing through. This dark color is continued in an arrow-shaped, or halberd-shaped, spot occupying most of the upper surface of the head. At the sides of the head and body is a mottling of light yellowish gray, darker again on the edge. The under surface of the body and the legs are pale and generally uniform in color. In alcohol the colors usually fade to a uniform straw color, with fine blackish dots, which are less conspicuous in life.

According to Say this species extends as far south as Florida. It is common on sandy beaches at many localities on the coast of New England, as at New Haven! and other localities on Long Island Sound!,

Vineyard Sound!, Nantucket!, Provincetown!, and Nahant, Mass.! It appears to be very rare, or perhaps does not occur in the northern part of the Gulf of Maine, where it is replaced by the next species; it reappears, however, on the coast of Nova Scotia, having been collected at low water by the U. S. Fish Commission in 1877, at Halifax!. It is usually found on sand below high tide, or burrowing just under the surface, but also swims with facility.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1944	New Haven. Vineyard Sound, Mass.	.....	Sand..... .....do.....	—, 1871	U. S. Fish Com.	00	♂ ♀	Alc. Alc.
1945	Off Nantucket.....	.....	.....	Sept. 8, 1875	do.....	1	.....	Alc.
1946	Provincetown, Mass.	.....	Sand.....	—, 1872	do.....	1	.....	Alc.
1947	Nahant, Mass.	L. w.	.....	.....	A. E. Verrill	3	.....	Alc.
1948	Halifax, N. S.	L. w.	.....	—, 1877	U. S. Fish Com.	.....	.....	Alc.

***Chiridotea Tuftsii* Harger (Stimpson).**

Idotea Tuftsii Stimpson, Mar. Inv. G. Manan, p. 39, 1853.

Verrill, Proc. Am. Assoc., 1873, p. 362, 1874; This Report, part i, p. 340 (46), 1874.

Harger, This Report, part i, p. 569 (275), 1874.

Chiridotea Tuftsii Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 159, 1879.

PLATES IV AND V, FIGS. 20-23.

This species is distinguished from the preceding by its smaller size and longer antennæ, which are about twice as long as the antennulæ and bear a slender flagellum. The eyes are also more conspicuous than in *Ch. cæca*.

The head is excavated in front above the bases of the antennæ; and the incision in the produced lateral margin is nearly closed by the overlapping of the anterior lobe. The antennulæ (pl. V, fig. 23 *a*) are slender and do not surpass the peduncle of the antennæ, the second segment as well as the third is cylindrical, and the last segment bears about nine tufts of short hairs; the peduncular segments bear also a few bristles. The antennæ (pl. V, fig. 23 *b*) have the first segment short; the second, third and fourth about equal in length and more than twice as long as the first; the fifth as long as the third and fourth together, but more slender and cylindrical; the flagellum longer than the peduncle, composed of about twelve segments and tapering from the base. The maxillipeds (pl. IV, fig. 21) have the external lamella (*e*) longer than broad.

The first pair of legs (pl. V, fig. 23 *c*) are somewhat less robust than in *Ch. cæca*. They are a little shorter than the second and third pairs, and

have a much more robust hand. The fourth and succeeding pairs of legs (pl. V, fig. 23 *d*) are much as in the preceding species but less spiny and with a greater proportion of plumose hairs.

The external apical plate of the operculum (pl. V, fig. 23 *e*) is slender and twice as long as broad. The stylet on the second pair of pleopods in the males (pl. IV, fig. 22 *s*) does not surpass the cilia, is dilated towards the tip and obtusely pointed.

Length 9^{mm}; breadth 4.5^{mm}. The color is usually light reddish brown, speckled with darker, or marked with dark transverse patches, or bands. A specimen obtained during the summer of 1879, from a clear sandy bottom in 17 fathoms, Stellwagen's Bank, is thus described from life by Professor Verrill: "Color whitish, more or less speckled with salmon on the sides above, the specks more regular and distinct on the head, some lines and specks of flake-white on the middle of the back above the greenish stomach; base of telson salmon brown, its posterior half white; legs marked with salmon."

Dr. Stimpson's specimen "was dredged on a sandy bottom in 10 fathoms off Cheney's Head" in the Bay of Fundy. It occurs in Long Island Sound, where a specimen was taken by Dr. T. M. Prudden off New London! in 1872. The species was, however, considered rare on the coast until 1878, when it was taken in considerable abundance in Gloucester Harbor, ! Massachusetts Bay, in seven to eight and a half fathoms, sand and red algæ. It has also been collected at Casco Bay, ! Maine, in 1873; at low water in Prince's Cove, ! Eastport, in the Bay of Fundy, in 1872, and at Halifax, N. S., ! in 18 to 25 fathoms, sand, September 5, 1877; a single specimen in each case. Three additional specimens were obtained in 1879, as detailed below.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1953	Off New London.....	8½	Sand.....	—, 1872	T. M. Prudden	1	♂	Alc.
	Gloucester Harbor, Massachusetts Bay	7½	do.....	—, 1878	U. S. Fish Com.	10		Alc.
	do.....	17	do.....	—, 1878	do.....	00		Alc.
	Stellwagen's Bank..	16	Coarse sand.....	Sept. 6, 1879	do.....	1	♀	Alc.
	Off Boston Harbor..	16	Speckled sand ..	Sept. 13, 1879	do.....	2	♂ ♀	Alc.
803	Casco Bay, Me.....		Sand.....	July 12, 1873	do.....	1		Alc.
1952	Bay Fundy, Prince's Cove.	L. w.	do.....	—, 1872	do.....	1	♀	Alc.
	Halifax, outer harbor.	18-25	do.....	Sept. 5, 1877	do.....	1		Alc.

Idotea Fabricius.

Idotea Fabricius, Suppl. Ent. Syst., p. 297, 1798.

Flagellum of the antennæ articulated; legs all terminated by a prehensile hand; epimeral sutures evident above except in the first thoracic

segment; pleon composed apparently of four segments, of which the last two are consolidated in the dorsal region; operculum with a single apical plate.

The species to which I propose to limit the name *Idotea** may be briefly characterized as above, and, of these, the three found on our coast agree further as follows: The body is elongated, its length being from three to four times its breadth, and the sides are nearly parallel. The head is quadrate and not produced at the sides. The eyes are lateral. The antennulæ are small and short, hardly surpassing the third segment of the antennæ. The basal segment of the antennæ is very short; the second segment much larger and deeply incised on its under surface; the third, fourth and fifth segments increase in length but decrease in diameter; the flagellum is more or less distinctly articulated, the number of articulations increasing with age. The palpus of the maxillipeds is four-jointed, the last segment being composed of two segments united, as is indicated by a notch near the tip.

The thorax is moderately arched, with the sides but little dilated in the males, somewhat more so in the females. The epimera are conspicuous and separated from their segments by a suture above, except in the first segment, but may not occupy its entire lateral margin. The legs differ but little in form throughout, being all more or less perfectly prehensile, but in the first pair only is the carpus triangular.

The pleon or abdomen appears, when seen from above, to consist of four segments, of which the first two are separated by complete sutures, but the third and fourth by sutures at the sides only. The uropods, forming the abdominal operculum, consist on each side of a flattened, elongated plate, with the anterior end rounded, the sides nearly parallel for most, or all, of its length and bearing at its truncated apex a much shorter more or less tapering or triangular plate. Neither of these plates is strongly ciliated in our species, but a stout, densely plumose bristle springs from the basal plate, on the inside, near the outer end of the articulation between the two plates. The stylet on the second pair of pleopods of the males is not elongated and may not surpass the lamella to which it is attached. The incubatory pouch is conspicuous in the females.

Our representatives of this genus may be recognized among the other known Isopoda of the coast by the following characters: The pleon appears to consist of four segments, the first three short and the third united, in the dorsal region, to the large, more or less vaulted, terminal segment; underneath the pleon is the conspicuous two-valved operculum and, in the antennæ, the flagellum consists of several segments. The three species may be distinguished by the form of the tip of the pleon, which is more or less tridentate in *I. irrorata* (p. 343), pointed in *I. phosphorea* (p. 347), and truncate in *I. robusta* (p. 349).

* The orthography adopted is that of Fabricius, the author of the genus.

***Idotea irrorata* Edwards (Say).**

Idotea entomon Leach, Edinb. Encyc., vol. vii, (Am. ed., p. 243, pl. ccxxi, fig. 7), "1813-14"; Trans. Linn. Soc., vol. xi, p. 364, 1815 (not *Oniscus entomon*. Linné.)

Templeton, Loud. Mag. Nat. Hist., vol. ix, p. 92, 1836.

Moore, Charlesworth's Mag. Nat. Hist., vol. iii, p. 294, 1839.

Stenosoma irrorata Say, Jour. Acad. Nat. Sci., vol. i, pp. 423, 444, 1818.

Hitchcock, Rep. Geol. Mass., p. 564, 1833.

Gould, Rep. Geol. Mass., 2 ed., p. 549, 1835; Invert. Mass., p. 338, 1841.

Dekay, Zool. New York, Crust., p. 43, pl. ix, fig. 42, 1844.

Idotea tricuspidata Desmarest, Dict. des Sci. nat., tom. xxviii, p. 373, pl. 46, fig. 11, 1823; Consid. Crust., p. 289, pl. 46, fig. 11, 1825.

"Roux, Crust. Medit., t. 29, f. 11, 12," (B. & W.)

Latreille, Regne Anim., t. iv, p. 139, 1829.

Gould, Rep. Geol. Mass., 2 ed., p. 549, 1835 (*tricuspidata* ?).

Edwards, Hist. nat. des Crust., tom. iii, p. 129, 1840.

Cersted, Naturhist. Tidssk., B. iii, p. 561, 1841.

Zaddach, Crust. Pruss. Prod., p. 10, "1844."

Lucas, Expl. Algérie, tom. i, p. 60, 1849.

White, List Crust. Brit. Mus., p. 94, 1847; Brit. Crust. Brit. Mus., p. 65, 1850; Pop. Hist. Brit. Crust., p. 223, pl. 12, fig. 2, 1857.

Hope, Cat. Crost. Ital., p. 26, 1851.

Lilljeborg, Öfvers. Vet.-Acad. Förh., Årg. 9, p. 11, 1852 (*Idothea*).

M. Sars, Chr. Vid. Selsk. Forh., 1858, p. 151, 1859 (*Idothea*.)

Bate, Rep. Brit. Assoc., 1860, p. 225, 1861.

Norman, Nat. Hist. Trans. Northumb., vol. i, p. 25, 1865; Rep. Brit. Assoc., 1866, p. 197, 1867; op. cit., 1868, p. 289, 1869.

G. O. Sars, Reise ved Kyst. af Christ., 1865, p. (28), 1866 (*Idothea*).

Heller, Verh. zool.-bot. Ges. Wien, B. xvi, p. 728, 1866 (*Idothea*).

Marcusen, Arch. Naturges., Jahrgang xxxiii, B. 1, p. 360, 1867.

Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 379, figure, 1868.

"Sænger, Fauna of Baltic, Imp. Soc. Nat. Sc. Mosc., viii, 1869."

"Münter und Buchholz, Carcin. Fauna Deutschlands, 1869."

Czerniavski, Zoog. Pont. Comp., pp. 83, 129, "1870."

Metzger, J. B. Naturhist. Ges. Hannover, vol. xx, p. 32, 1871; Nordseefahrt der Pomm., 1872-73, p. 235, 1875.

Möbius, Die Wirbellosen Thiere der Ostsee, p. 121, 1873. Ann. Mag. Nat. Hist., IV, vol. xii, p. 85, 1873.

Parfitt, Trans. Devon. Assoc., Sess. Crust., p. (19), 1873.

Bos, Bijd. ken. Crust. Hed. Nederl., pp. 34, 67, 1874.

M'Intosh, Ann. Mag. Nat. Hist., IV, vol. xiv, p. 273, 1874.

Stebbing, Jour. Linn. Soc., vol. xii, p. 148, 1874.

Catta, Ann. Sci. nat., Zool., VI, tome iii, p. 30, 1876.

Stalio, Cat. Crost. Adriatic, p. 206, 1877.

Lenz, Wirbellos. Thiere, Trave. Bucht, p. 15, 1878.

Idotea Basteri Audouin, Descr. Savigny's Egypt, Crust., pl. 12, fig. 6, "1830."

Guerin. Iconog., Crust., p. 32, pl. xxxi, fig. 1, 1829-43.

"Roux, Crust. Mediterr., t. 29, f. 1-10," 1830 (B. & W.).

"Rathke, Fauna der Krimm, p. 380," 1830 (Edw.).

"*Idotea variegata* Roux, Crust. Mediterr., pl. 30, fig. 1-9," 1830 (B. & W.).

Idotea (pelagica) ? Latreille, Cours d'Ent., Atlas, p. 12, pl. xviii, figs. 20-30, 1831.

"*Armida bimarginata* Risso, Hist. nat. Eur. merid., 5, 109" (B. & W.).

Idotea irrorata Edwards, Hist. nat. des Crust., tome iii, p. 132, 1840.

White, List Crust. Brit. Mus., p. 94, 1847.

Stimpson, Mar. Inv. G. Manan, p. 39, 1853.

Leidy, Jour. Acad. Nat. Sci. Phil., II, vol. iii., p. 150, 1855.

Idotea irrorata—Continued.

- Harger, This Report, part i, p. 569 (275), pl. v, fig. 23, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.
- Verrill, Am. Jour. Sci., III, vol. vii, pp. 131, 135, 1874; Proc. Amer. Assoc., 1873, pp. 369, 371, 373, 1874; This Report, part i, p. 316 (22), 1874.
- Whiteaves, Am. Jour. Sci., III, vol. vii, p. 217, 1874; Further Deep-sea Dredging, Gulf of St. Lawrence, p. 15, "1874."
- Idothea tridentata* Rathke, Fauna Norw., Nov. Act. Acad., B. xx, p. 21, 1843 (*I. tridentata* Latreille?).
- Grube, Ausflug nach Triest, p. 126, 1861.
- ? *Idotea tricuspis* Dekay, Zool. New York, Crust., p. 42, pl. 9, fig. 35, 1844.
- Oniscus Balthicus* (*Idotea marina*) Dalyell, Powers of the Creator, vol. i, p. 228, pl. lxiii, figs. 5-9, 1851 (*O. Balthicus* Pallas?).
- Oniscus* (*Idotea*) *entomon* Dalyell, op. cit. vol. i, p. 229, pl. lxiii, fig. 10, 1851 (not *O. entomon* Linné.).
- Idothea pelagica*, M. Sars, Chr. Vid. Selsk. Forh., 1858, p. 151, 1859 (not of Leach).
- "*Idotea acuminata* Eichwald, Fauna Caspio-Caucasia, p. 232-233, tab. xxxvii, fig. 6, 1842" (Czerniavski).
- Idothea balthica* Meinert, Crust. Isop. Amph. Dec. Daniæ, pp. 21, 228, etc., "1877" (*Oniscus Balthicus* Pallas?).

PLATE V, FIGS. 24-26.

Adults of this species are at once distinguished from the other species of the genus on our coast by the tridentate abdomen, or pleon, and young individuals, which often resemble *I. phosphorea*, may be distinguished by the epimeral sutures, which extend quite across the second and succeeding thoracic segments. For character separating them from the other Isopoda of the coast, see at the close of the generic description.

The body is smooth, not tubercular nor roughened. The head is nearly square, narrowing but slightly behind. The eyes are small. The antennulæ (pl. V, fig. 25 *a*) are short, hardly surpassing the third segment of the antennæ. The flagellum of the antennæ (pl. V, fig. 25 *b*) is longer than the peduncle, distinctly articulated, slender, and composed of from twelve to sixteen segments in the adults. When reflexed it reaches the third thoracic segment. The external lamella (*l*) of the maxillipeds (pl. V, fig. 26 *a*) is about twice as long as broad, and is obliquely truncated.

Thorax with the external margins, as seen from above, forming in the adults, a pretty regular curved line, the segments being marked by incisions instead of by serratures as in the other species. In the second and third, as well as in the posterior segments, this margin is formed wholly by the epimera.

The first three segments of the pleon terminate in acute teeth at the sides. The fourth, or last segment, has its lateral margins straight, and is more or less tridentate at the tip, the middle tooth being much the largest. In the operculum (pl. V, fig. 25 *c*) the basal plate is about three times as long as the terminal one, which is broadly truncate at the apex. The stylet (*s*) on the second pair of pleopods in the males (pl. V, fig. 26 *b*) is usually shorter than, or, in smaller specimens, about as long as the lamella to which it is attached, and is abruptly bent toward the

lamella at the apex and very obliquely truncated. It is minutely serrulate toward the tip on the side opposite the lamella.

The males of this species sometimes attain a length of 30^{mm} to 38^{mm}, with a breadth of 8^{mm} to 9^{mm} but the females are smaller, rarely, if ever, exceeding 20^{mm} in length, with a breadth of 6.5^{mm}, and are found with eggs when not over 7.5^{mm} in length. The color varies greatly. Frequently it is of a nearly uniform light or dark green, or brownish with minute blackish punctations. It is often longitudinally striped with light color, or nearly white on a dark background, and the stripes may be marginal only, or accompanied, especially in the males, by a median dorsal stripe. More rarely the colors are arranged transversely in bands or blotches, and specimens thus marked are easily mistaken for the next species. The females are usually darker than the males, and often with a light lateral stripe, which may be very narrow or broken into a series of blotches.

A comparison of specimens from both sides of the Atlantic does not seem to furnish any characters by which to separate this species from the common European form, *I. tricuspidata* Desm., and as Say's trivial name has priority I have adopted it. *I. tridentata* Rathke appears to be the same species, but *I. tridentata* Latreille* is described by that author as having antennæ as long as the body; further, Desmarest, just before his original description of *I. tricuspidata* says: "M. Latreille fait observer que cette idotée [*I. entomon*] est bien différente de celle que M. Leach a décrite sous le même nom, * * * * cette dernière qu'il nomme Idotée tricuspidée," &c. It would not therefore appear that Latreille was at that time aware that this species had a name, much less that he had himself named it *I. tridentata*. Again, in his Cours d'Entomologie, where he copies figures, doubtless of this species, from Savigny's Egypt, he applies to them the name *Idotea* (*pelagica*?), not recognizing them as his own species. Bate and Westwood quote *I. tridentata* Latreille as a synonym of *I. tricuspidata* Desm., and their quotation† appears intended to refer to a work nearly twenty years older than that of Desmarest. They do not, however, give their reasons for deviating from the ordinary rules of priority, but, perhaps, considered as sufficient the authority of Edwards, who does the same thing. Edwards' description of *I. tricuspidata* Desm. contains, moreover, an evident error, the species being placed in a section of the genus which he thus describes: "§ 2 Espèces dont l'abdomen se compose de trois articles parfaitement distincts (le second étant composé de deux anneaux soudés ensemble sur le milieu du dos, mais séparés par une scissure sur les côtés)." *I. irrorata* is included in the same section, but under a subsection, thus correctly characterized: "aa Le second article de l'abdomen simple; le troisième offrant près de sa base une fissure de chaque

* Gen. Crust. et Ins., tome i, p. 64, 1806.

† Brit. Sess. Crust., vol. ii, p. 380. The quotation reads, "*Idotea tridentata* Latreille, Con. Crust. et Ins. 1, p. 64," and was doubtless intended for Gen. Crust. et Ins., [tome] i, p. 64, [1806].

côté." No species of *Idotea* that I have seen has the second segment of the pleon composed of two segments, united along the back but separated by an incision at the sides, as described in the parenthesis above, and two certainly of the other species included by Edwards in the section with *I. tricuspidata* agree with it in the structure of the pleon as described in *I. irrorata*. Meinert unites this species with *I. pelagica* Leach under the name *I. Balthica* (Pallas), and in this he may be right, but not being able to consult Pallas' work, I have preferred to use the earliest name that I could certainly connect with the species, rather than to introduce further confusion by adopting a name of the applicability of which I could not satisfy myself. M. Sars also regarded *I. pelagica* Leach as synonymous with *I. tricuspidata*, and says it is found as far north as Tromsø and southward to the Mediterranean, from which statements I conclude that he intended the present species.

This species is found along the whole coast of New England! and extends southward along the coast of New Jersey at least as far as Great Egg Harbor! and northward to Nova Scotia! and the Gulf of St. Lawrence, where it has been collected by Mr. J. F. Whiteaves. From Cape Cod southward it is abundant, but toward the north it is, mostly replaced by *I. phosphorea*. It is commonly found among sea-weed along the rocky shores of bays and sounds or among the rocks, where its variety of colors affords it protection. It is also found far from land, attached to floating sea-weed, and was thus taken by Professor S. I. Smith and the writer on George's Banks!, September 14 and 15, 1872, at about 41° N. lat., 65° W. lon. One of these specimens was quite large, measuring 38^{mm} in length, but most of them were of moderate size or small. Young individuals are often taken at the surface. According to European authors it is common on the shores of Great Britain and Ireland (B. & W.); on all the shores of the North Sea (Metzger *et al.*); (*I. pelagica*) as far north as Tromsø (M. Sars); in the Baltic, the Mediterranean, the Adriatic (Heller, Stalio, *et al.*), the Black (Czerniavski *et al.*) and the Caspian ("Eichwald") Seas, and, as with us, is of variable color and varies also somewhat in the shape of the termination of the pleon, which is, however, more or less three-toothed.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of Specimens.	Dry. Alc.
1078	Fire Island Beach, L. I.	.....	.....	—, 1870	S. I. Smith	50	Alc.
1079	do.	.....	.....	—, 1870	do.	9	Glyc.
1954	New Haven, Conn.	.....	.....	Nov. —, 1874	A. E. Verrill	1	Alc.
1955	Stony Creek, Conn.	.....	.....	Oct. 23, 1874	do.	00	Alc.
1958	Lyme, Conn.	.....	.....		D. C. Eaton	2	Alc.
1963	Long Island Sound, off Saybrook, Conn.	4	Sand	Aug. 3, 1874	U. S. Fish Com.	2	Alc.
1964	Off Stonington, Conn.	5	Sand and gravel.	Aug. 14, 1874	do.	12	Alc.
1959	Noank Harbor, Conn.	.....	Surface	July 13, 1874	do.	30	Alc.

Specimens examined—Continued.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
1960	Noank Harbor, Conn.	.....	Eel-grass	Aug. 28, 1874	U. S. Fish Com.	3	Alc.
1961	Fisher's Island	.....	.....	—, 1874	do	3	Alc.
1962	Watch Hill, R. I.	.....	.....	Oct. —, 1872	D. C. Eaton	2	Alc.
1965	Vineyard Sound Mass.	Sf	.....	—, 1875	U. S. Fish Com.	1	Alc.
1966	do	.....	.....	—, 1875	do	7	Alc.
2153	do	.....	.....	Oct. 24, 1875	do	00	Alc.
1968	Provincetown, Mass.	L. w.	.....	—, 1872	Smith & Harger	2	Alc.
do	do	.....	Shore	Aug. —, 1879	U. S. Fish Com.	00	Alc.
do	do	L. w.	.....	Aug. —, 1879	do	00	Alc.
do	do	.....	Eel-grass	Aug. —, 1879	do	00	Alc.
do	do	Sf	.....	Sept. 4, 1879	do	10	Alc.
426	Beverly, Mass.	.....	.....	.....	A. E. Verrill	8	Alc.
do	Gloucester, Mass.	.....	Tide-pool	—, 1878	U. S. Fish Com.	2	Alc.
do	Gloucester, Mass., Outer Harbor	7-10	Sand, red algæ	—, 1878	do	00	Alc.
do	Between Boon Island and Matinicus Rocks.	.....	.....	—, 1878	Capt. G. H. Martin	5	Alc.
do	Casco Bay, Me.	.....	.....	—, 1873	U. S. Fish Com.	11	Alc.
1975	Casco Bay, Ram I.	L. w.	.....	—, 1873	do	4	Alc.
2150	George's Bank	Sf	.....	Sept. —, 1872	Smith & Harger	6	Alc.
1977	Bay of Fundy	L. w. & sf	.....	—, 1872	U. S. Fish Com.	2	Alc.
1978	Off Halifax, N. S.	.....	.....	—, 1877	do	1	Alc.
1979	Nova Scotia	L. w.	.....	—, 1877	do	1	Alc.
do	Durham coast, England	.....	.....	.....	Rev. A. M. Norman	4	Alc.
do	St. Vaast, la Hogue	.....	.....	.....	Jardin des Plantes.	1	Alc.

Idotea phosphorea Harger.

Idotea phosphorea Harger, This Report, part i, p. 569 (275), 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

Verrill, Am. Jour. Sci., III, vol. vii, pp. 43, 45, 131, 1874; Proc. Amer. Assoc., 1873, pp. 362, 367, 369, 1874; This Report, part i, p. 316 (22), 1874.

Whiteaves, Am. Jour. Sci., III, vol. vii, p. 218, 1874; Further Deep-sea Dredging, Gulf of St. Lawrence, p. 15, "1874."

PLATE V, FIGS. 27-29.

This species may be distinguished from the others on this coast by the pointed abdomen or pleon. Young individuals sometimes resemble the young of *I. irrorata*, but may still be distinguished by the epimeral sutures of the second and third thoracic segments, which do not entirely cross the segment, but allow more or less of the posterior part of the edge of the segment to form a part of the margin of the animal as seen from above. From *Synidotea nodulosa* it may be distinguished by the evident epimeral sutures and by the three acute teeth at the base of the pleon on each side, instead of a single obtuse tooth, as in that species. For characters separating it from the other Isopoda of the coast see at the close of the description of the genus.

The body, especially of the young, is rough and tubercular along the median line and often also laterally. Older specimens are much smoother, losing their large median tubercles but never becoming as smooth as in the preceding species. The head is narrowed behind. The eyes are of moderate size. The flagellum of the antennæ (pl. V, fig. 28 a) is shorter than

the peduncle, and consists of about ten to fourteen segments. The maxillipeds (pl. V, fig. 28 *b*) have the external lamella (*l*) broader than in the preceding species, with its inner margin straight and its outer margin curving pretty regularly to a slightly attenuated tip.

The epimera of the second, third, and fourth pairs are rounded behind, and those of the last three pairs are less acute than in *I. irrorata*.

Pleon ovate, a little constricted near the middle and pointed, its three proximal segments rather less acute than in the preceding species. The basal plate of the operculum (pl. V, fig. 28 *e*) tapers toward the end, and the terminal plate is triangular, a little longer than broad. The stylet on the second pair of pleopods in the male (pl. V, fig. 29 *s* and *s'*) is slender, nearly straight, surpasses the lamella to which it is attached, and is obliquely truncate.

Length 25^{mm}; breadth 7^{mm}. The color is very varied, usually dark green or brownish, with patches of yellow or whitish, transversely or obliquely arranged. I have never observed a striped pattern of coloration, so common in *I. irrorata*, and it must occur very rarely if at all. The color is usually darker than in that species.

This species is found associated with the last among rocks and seaweed along the entire coast of New England! and extends northward to Halifax!, Nova Scotia, and the Gulf of St. Lawrence!. It appears to be a more northern species than *I. irrorata*, as it is comparatively rare south of Cape Cod, while it is abundant in Casco Bay, Maine, and in the Bay of Fundy.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1980	South End, New Haven, Conn.	.....	.....	Nov. —, 1874	A. E. Verrill	.....	.....	Alc.
1981	Stony Creek, Conn.	.....	.....	Sept. 23, 1874	do	.....	.....	Alc.
1983	Off Saybrook, Conn.	4	Sand	Aug. 3, 1874	U. S. Fish Com.	.....	.....	Alc.
1984	Long Island Sound	.....	.....	Aug. 10, 1874	do	3	y.	Alc.
1985	South Fisher's Island.	9	.....	Aug. 21, 1874	do	1	.....	Alc.
1987	Vineyard Sound, Mass.	.....	.....	— —, 1871	do	.....	.....	Alc.
1986	do	.....	.....	— —, 1872	do	.....	.....	Alc.
2147	do	.....	.....	.....	do	1	.....	Alc.
1990	Off Nantucket	15	.....	Sept. 8, 1875	do	1	y.	Alc.
	Cape Cod Bay	14	Green mud	Sept. 15, 1879	U. S. Fish Com.	2	.....	Alc.
	do	7	Coarse yellow sand.	Sept. 15, 1879	do	3	.....	Alc.
144	Nahant, Mass.	.....	.....	.....	A. E. Verrill	3	.....	Alc.
	Gloucester, Mass.	7-10	Sand and algæ	— —, 1878	U. S. Fish Com.	00	♂ ♀ y.	Alc.
	Ten Pound Island, Gloucester, Mass.	.....	.....	— —, 1878	do	.....	.....	Alc.
	Annisquam, Mass.	1	.....	— —, 1878	A. Hyatt	20	.....	Alc.
1991	Casco Bay, Me.	St.	.....	Aug. 4, 1873	U. S. Fish Com.	1	y.	Alc.
1992	do	.....	.....	— —, 1873	do	4	.....	Alc.
1993	Casco Bay, Ram Island.	L. w.	.....	— —, 1873	do	4	.....	Alc.
1994	Bay of Fundy	.....	.....	— —, 1872	do	1	♀	Alc.
	Bay of Fundy, Whiting River.	.....	.....	— —, 1872	do	00	♂ ♀	Alc.
	Off Halifax, N. S.	18	.....	— —, 1877	do	2	.....	Alc.
	Egmont Bank, Gulf of St. Lawrence.	.....	.....	— —, 1873	J. F. Whiteaves.	1	.....	Alc.

***Idotea robusta* Kröyer.**

- ! *Idotea metallica* Bosc, Hist. nat. des Crust., tom. ii, p. 179, pl. 15, fig. 6, 1802.
Idothea robusta Kröyer, Naturhist. Tidssk., II, B. ii, p. 108, 1846; Voy. en Scand., Crust., pl. 26, fig. 3, "1849."
 Reinhardt, Grönlands Krebsdyr, p. 35, 1857.
 Stimpson, Proc. Acad. Nat. Sci., 1862, p. 133, 1862.
 Verrill, Am. Jour. Sci., III, vol. ii, p. 360, 1871; This Report, part i, p. 439 (145), 1874 (*Idotea*).
 Harger, This Report, part i, p. 569 (275), pl. v, fig. 24, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879 (*Idotea*).
 Lütken, Crustacea of Greenland, p. 150, note, 1875.

PLATE VI, FIGS. 30-32.

This species is easily recognized within the genus by the pleon, which is broadly truncate at the apex and not at all pointed. The pleon is also large and more swollen above than in the other species. For characters separating it from other Isopoda, see near the close of the generic description.

The entire upper surface, except perhaps that of the pleon, is somewhat rugose. The head is nearly square, with the eyes large and prominent. The antennæ (pl. VI, fig. 31 *a*) have the second segment large, the flagellum short, usually of less than ten articulations. Under a sufficient power these organs are seen to be clothed with a very fine close pubescence, which also occurs in a less degree upon the legs. The maxillipeds (pl. VI, fig. 32 *a*) have the external lamella (*l*) short and oval.

The legs are robust and spiny. The epimera, projecting, give a serrated appearance to the sides of the thorax, as seen in figure 30, plate VI, and the dorsum is more convex than in the other species.

The pleon is large and convex, its sides are nearly parallel beyond the middle, and it is broadly truncate, or even somewhat emarginate, at the apex. The basal plate of the operculum (pl. VI, fig. 31 *c*) is elongated, with parallel sides; the terminal plate less than one-fourth as long and nearly square, but tapering slightly and somewhat broader than long. The male stylet on the second pair of pleopods (pl. VI, fig. 32 *c, s*) reaches the end of the lamella, to which it is attached, and is slightly curved and rounded at the tip.

Length of male 28^{mm}; female 22^{mm}; breadth 9^{mm}. Color bright blue or green above when alive, becoming darker and dull in alcohol, without the markings of the other species, but often with metallic reflections, when seen in the water, where it is commonly taken swimming free or among masses of floating sea-weed.

It is thus found in mid-ocean, and was described by Kröyer from specimens taken in about 60° north latitude between Iceland and Greenland. It was taken in considerable abundance at Fire Island Beach!, on the south shore of Long Island, by Professor S. I. Smith in 1870; also by the U. S. Fish Commission at Vineyard Sound!, Mass., often in company with *I. irrorata* Edw.; at George's Banks!, September, 1872, small specimens, 5^{mm} in length; between Boon Island and Matinicus Rocks, near the

Isles of Shoals!, by Capt. G. H. Martin, of the schooner 'Northern Eagle,' in 1878, and at Halifax!, Nova Scotia, by the U. S. Fish Commission in 1877, whence it extends to at least 60° north latitude.

The figure and description of *Idotea metallica* given by Bosc correspond well with small specimens of this species such as were taken by Professor S. I. Smith and the writer on George's Banks, and the locality he gives, "the high seas," corresponds also with the habit of this species, so that I am inclined to think that his name ought to be restored. I have, however, retained Kröyer's name, since he so thoroughly described and so well figured the species as to leave no doubt of its identity.

Specimens examined.

Number.	Locality.	Habitat.	When collected.	Received from—	Specimens.		Dry. Alc.
					No.	Sex.	
1080	Fire Island Beach, Long Island...	Surface....	—, 1870	S. I. Smith....	46	♂ ♀	Alc.
1998	Vineyard Sound, Mass.....	Surface....	—, 1875	U. S. Fish Com.	1	.....	Alc.
1999	do.....	Surface....	.....	.....do.....	00	♂ ♀	Alc.
2002	do.....	Surface....	July 14, 1871	do.....	2	.....	Alc.
2003	do.....	Surface....	Oct. 24, 1875	V. N. Edwards	00	.....	Alc.
2004	do.....	Surface....	Nov. 16, 1875	do.....	00	.....	Alc.
2000	George's Bank.....	Surface....	Sept. —, 1872	Smith & Harger	4	y.	Alc.
2001	Halifax, N. S.....	Surface....	—, 1877	U. S. Fish Com.	1	.....	Alc.

Synidotea Harger.

Synidotea Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.

Antennæ with an articulated flagellum; epimeral sutures not evident above; pleon apparently composed of two segments, united above but separated at the sides by short incisions; operculum with a single apical plate; palpus of maxillipeds three-jointed.

Of the two species that I had referred to this genus I had been able to examine only the first when this paper was placed in the hands of the printer. Two specimens of the second species were collected during the summer of 1879, and an examination of their characters leaves no doubt of their generic affinity. Except in the particulars above specified the description already given of the genus *Idotea* will in general apply also to the present, but the species are characterized by a firmer and more solid structure, the segments being more closely articulated and the integument having a somewhat shelly appearance. The pleon is further consolidated than in that genus, the only trace of its composite nature, as seen from above, being a slight incision on each side near the base and running up somewhat obliquely toward the dorsal surface. The well-developed and distinctly articulated flagellum of the antennæ serves easily to distinguish the species from those of the following genera of the family.

Synidotea nodulosa Harger (Kröyer).

Idothea nodulosa Kröyer, Naturhist. Tidssk., II, B. ii, p. 100, 1846; Voy. en Scand., Crust., pl. 26, fig. 2, 1849.

Reinhardt, Grønlands Krebsdyr, p. 34, 1857.

Lütken, Crust. Greenland, p. 150, "1875."

Synidotea nodulosa Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

PLATE VI, FIGS. 33-35.

This species may be recognized most easily by the pleon, which is entire, except for a slight incision near the base on each side, and tapers to a blunt but not at all bifid point. The articulated flagellum of the antennæ distinguishes it from *Erichsonia*.

The head and body are roughened and tubercular, having a prominent median row of tubercles and coarse rugæ along the sides of the thorax. The head has a median notch in front, and immediately above this a prominent tubercle directed forward, and succeeded on the median line by two less prominent tubercles. In front of each eye is a still larger tubercle, directed forward and projecting over the anterior margin of the head; behind and within, there are two smaller oval tubercles. The eyes are large, convex, and very prominent. The peduncular segments of the antennæ (pl. VI, fig. 34*b*) increase gradually in length from the first and decrease in diameter from the second, which lacks the lateral incision seen in *Idotea*. The flagellum is distinctly articulated, with about nine segments, of which the last two are very minute. The maxillipeds (pl. VI, fig. 35*a*) have the external lamella (*l*) of an irregular shape, emarginate on the inner side and obtusely pointed. The outer maxillæ (pl. VI, fig. 35*b*) are armed on their external lobe with strong, curved, pectinated setæ, which become much elongated and stout at the tip of the lobe. The inner maxillæ (pl. VI, fig. 35*c*) resemble these organs in other members of the family.

The first four thoracic segments have their external margins rounded. In the last three the margins are more nearly straight, but with rounded angles. The first pair of legs (pl. VI, fig. 34*c*) are much shorter than the second, and the propodus in the first pair is bristly on what is, in the ordinary position, the upper side.

The pleon is short, and tapers from the base. It is convex, bears two or three small tubercles on the median line near the base, and an impressed transverse line in continuation of the short lateral incisions. The basal plate of the operculum (pl. VI, fig. 34*d*) is oblique at the base with rounded angles, and is somewhat vaulted, with an oblique elevation extending from the articulation to the inner distal angle. The inner margin is straight, and the outer parallel with it to near the end. The terminal plate is slightly oblique at the base, and is elongated triangular, about twice as long as broad. The free margins are finely ciliated, except at and near the base, and the inner margin of the basal plate bears also scattered stouter hairs. The stylet of the males on the second pair of pleopods (pl. VI, fig. 35*d, s*) is longer and stouter than in any of our species

of *Idotea*. It is nearly twice the length of the lamella, to which it is attached, and of an elongated spatulate form tapering to an obtuse point. The lamellæ are provided with but few cilia, which extend less than half the way from the end of the lamella to the end of the stylet.

Length 10.5^{mm}.; breadth 3.5^{mm}. Females proportionally broader; length 8.^{mm}; breadth 3^{mm}. Color in alcohol gray, often with brownish transverse markings.

This species seems to agree with *Idotea nodulosa* Kröyer, from Southern Greenland, as described and figured, except that the epimeral sutures are not evident above; the lateral margins of the segments are, however, somewhat thickened and prominent with rugæ, as shown in his figure, and I have no doubt that it is the same as his species. It was dredged off Halifax! by the Fish Commission at several localities in the summer of 1877, in from 16 to 190 fathoms on sandy and rocky bottoms, with red algæ at one locality. A specimen was brought from George's Banks! by Mr. Joseph P. Schemelia, of the schooner 'Wm. H. Raymond,' in the summer of 1879, and Mr. J. F. Whiteaves has sent to the Museum for examination two specimens collected by Mr. G. M. Dawson, in 111 fathoms, Dixon Entrance!, north of Queen Charlotte Island, British Columbia. The range of the species would therefore be, as at present known, from George's Banks to Greenland and the Arctic Seas, and southward on the Pacific coast as far as British Columbia..

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
2006	Dixon Entrance, Q. C. I.	111	-----	-----	J. F. Whiteaves	2	-----	Alc.
	Off Halifax, N. S.	16	Stones, sand, red algæ.	—, 1877	U. S. Fish Com.	2	-----	Alc.
2007	South of Halifax, 120 miles.	190	Gravel and pebbles.	Sept. 1, 1877	do	1	♀	Alc.
2008	Halifax, outer harbor	18	Sand, stones	Sept. 4, 1877	do	2	-----	Alc.
	do	16	Rocks, nullipore	Sept. 4, 1877	do	1	-----	Alc.
	George's Banks.	-----	-----	—, 1879	J. P. Schemelia	1	♀	Alc.

Synidotea bicuspidata Harger (Owen).

Idotea bicuspidata Owen, Crustacea of the Blossom, p. 92, pl. xxvii, fig. 6, 1839.

Streets and Kingsley, Proc. Essex Inst., vol. ix, p. 108, 1877.

Idotea marmorata Packard, Mem. Bost. Soc. Nat. Hist., vol. i, p. 296, pl. viii, fig. 6, 1867.

Whiteaves, Further Deep-sea Dredging in Gulf of St. Lawrence, p. 15, 1874.

Idotea pulchra Lockington, Proc. Cal. Acad. Sci., vol vii, p. 45, 1877.

Synidotea bicuspidata Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

This species may be most easily recognized among the known Isopoda of our coast by the form of the pleon, which is nearly triangular in shape, marked by a slight incision at each side near the base, and distinctly bicuspid at the tip.

The body is rather more robust than in the last species, the length being only about two and a half times the breadth, and is peculiarly marked above by depressed and mostly curved lines, varying in length but mostly short, and confined principally to a region on each side of the median line and extending across the head but not the pleon.

The head is broadly emarginate in front, with a median notch, and its antero-lateral angles are prominent. The eyes are at the widest part of the head, and are strongly convex. The posterior outline of the head is nearly in the form of three sides of a hexagon. The antennulæ attain about the middle of the fourth antennal segment. The antennæ are about one-half as long as the body. The first two antennal segments are short and apparently articulated so as to admit of but little motion; the third segment is a little longer than the first two taken together, and is the largest of the antennal segments in diameter; the fourth segment is somewhat longer than the third, and the fifth or last peduncular segment is the longest, and is followed by a flagellum, a little shorter than the peduncle and composed of about fourteen segments. The last three peduncular segments of the antennæ are somewhat bristly hairy. The maxillipeds are nearly as in the preceding species. The outer maxillæ are destitute of the elongated, pectinate setæ found in that species.

The thoracic segments vary but little in length measured along the median line, but the fifth, sixth, and seventh are slightly shorter than the preceding ones, and this difference is still greater measured along the margins of the segments, where the first is longest, the next three about equal, and the last three shorter. The legs are robust, the first pair shortest, and all more or less bristly hairy. The lateral margins of the segments are much less rounded than in *S. nodulosa*.

The pleon is short, the length being scarcely greater than the breadth at base; above, it is nearly smooth, the impressed lines, so conspicuous in the lateral region of the thorax, being continued for but a slight distance upon its surface. The incision at each side near the base is continued upward and forward by a depressed line on each side; the lateral margins are gently convex to near the tip, which is distinctly bicuspid. The basal plate of the operculum is traversed obliquely by a longitudinal ridge on the external surface, and is rounded in front, slightly narrowed behind, and bears a short, triangular, terminal plate, its length being but little greater than its breadth.

Length 15.5^{mm}; breadth 6^{mm}. Color in alcohol grayish, with white cloudings. Lockington says: "When recent, the coloration of this species is very beautiful, consisting of red cloudings on a lighter ground."

There seems to be no doubt in regard to the synonymy of this species as published by Streets and Kingsley, adopted by the writer in a previous publication, and given above.

The only specimens that I have examined were two, brought from the Grand Banks!, in the summer of 1879, by Mr. Charles Ruckley, of the

schooner 'Frederick Gerring, jr.', Capt. Edwin Morris. Dr. Packard's locality is "Sloop Harbor, Kynetarbuck Bay [Labrador], seven fathoms on a sandy bottom." Whiteaves records the species from Orphan Bank, Gulf of Saint Lawrence. Lockington's specimens were collected on the "west coast of Alaska, N. of Behring's Strait, by W. J. Fisher, naturalist of the U. S. S. Tuscarora, Deep-Sea Sounding Expedition." Owen's locality is "the Arctic Seas."

Erichsonia Dana.

Erichsonia Dana, Am. Jour. Sci., II, vol. viii, p. 427, 1849.

Antennæ six-jointed, the terminal or flagellar segment not articulated, clavate; palpus of the maxillipeds four-jointed; legs all nearly alike, prehensile or sub-prehensile; pleon with its segments consolidated into a single piece.

This genus is represented within our limits by two well-marked species, which further agree in the following characters: The head is quadrate, with the eyes lateral. The antennulæ are short, not surpassing the third segment of the antennæ. The antennæ are well developed, more than half as long as the body, with a very short basal segment articulated with little or no motion to the second segment, which is two or three times as long as, and of greater diameter than the first. It is, as usual in the family, incised at its distal end on the under surface. The next three segments are nearly cylindrical. The last or flagellar segment is the longest, and is slightly clavate.

The legs are all terminated by a prehensile or sub-prehensile hand, the dactylus being capable of considerable or complete flexion on the more or less swollen propodus. This flexion is most complete in the first pair. The first two pairs of legs arise near the anterior margin of the segments to which they belong. The place of attachment to the segment moves gradually backward in the following pairs until the last two pairs arise near the posterior margin of the last two segments. The epimera are more or less evident from above, at least in the last two segments.

The pleon constitutes about one-third the length of the body, and is consolidated into a single piece; it bears a more or less evident tooth on each side near the base, and is dilated and obtusely triangular at the apex. The basal plate of the operculum is oblique at the anterior end and abruptly narrowed posteriorly, where it bears a densely plumose bristle, as in *Idotea*; the terminal plate is triangular. The stylet on the second pair of pleopods in the males is well developed, surpassing the cilia; it is minutely denticulated or spinulose near the end and very acute.

The two species found on our coast have but a slight external resemblance to each other, and may be distinguished at a glance, as will be seen from the specific descriptions, and from the figures (pl. VI, fig. 36, and pl. VII, fig. 38). The long, clavate terminal segment of the antennæ

distinguishes them at once from young specimens of *Idotea*, especially *I. phosphorea*, which sometimes resemble *E. filiformis*. This character of the antennæ serves, indeed, to distinguish the two unlike representatives of the present genus from all the other Isopoda of our coast.

***Erichsonia filiformis* Harger (Say).**

Stenosoma filiformis Say, Jour. Acad. Nat. Sci., vol. i, p. 424, 1818.

Edwards, Hist. nat. des Crust., tom. iii, p. 134, 1840.

Decay, Zool. New York, Crust., p. 44, 1844.

Idotea filiformis White, List Crust. Brit. Mus., p. 95, 1847.

Erichsonia filiformis Harger, This Report, part i, p. 570 (276), pl. vi, fig. 26, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

Verrill, This Report, part i, p. 316 (22), 1874.

PLATE VII, FIGS. 38-41.

This species may be at once distinguished from the following by the strongly serrated outline of the sides, as seen from above. The clavate terminal segment of the antennæ distinguishes it from the other known Isopoda of our coast.

The body is slender and elongated, but less so than in the next species, the sides are nearly parallel and there is a median row of prominent tubercles, one, large and bifid, on the head, and one upon each thoracic segment. The eyes are prominent. The antennulæ (pl. VII, fig. 39 *a*) surpass the middle of the third antennal segment. The first segment of the antennæ (pl. VII, fig. 39 *b*) is very short; the terminal segment is bristly hairy toward the apex. The external lamella of the maxillipeds (pl. VII, fig. 41 *a*) is emarginate on the outer side toward the apex.

The thoracic segments each bear a prominent median tubercle near their posterior margins, and the first bears also a smaller tubercle near its anterior margin. In the first two segments the posterior external angles are salient and much elevated. The angulated epimera are evident from above in front of these projections. In the third and fourth segments both lateral angles are salient but not elevated. In the last three segments, only the anterior angles are produced, but the epimera fill the places of the posterior angles. This arrangement gives the appearance of fourteen teeth upon each side of the thorax, and the prominent divergent tooth on the pleon makes, in all, fifteen.

The operculum (pl. VII, fig. 39 *d*) is a little more vaulted than in the next species and shorter; the basal plate is less than three times as long as broad; the terminal plate is triangular. The stylet on the second pair of pleopods in the male (pl. VII, fig. 41 *b*, *s*) is slightly curved, finely spinulose near the apex on the side toward the lamella, and minutely and sharply denticulate on the opposite side at the apex, as shown in the enlarged figure (*s'*) of the distal portion of the stylet.

Length 11^{mm}; breadth 3.4^{mm}. The color is a usually dull neutral tint without bright markings, but sometimes more or less variegated with brown or reddish, fading in alcohol.

This species was originally described from Great Egg Harbor, New Jersey, where Say found it in company with *Idotea irrorata*. It is not uncommon along the shores of Long Island Sound! and as far east as Vineyard Sound, Mass.! but has not yet been found north of Cape Cod. It is usually found in tide-pools or among eel-grass and algæ, and has been taken from a depth of 7 fathoms.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2010	Long Island Sound	-----	-----	-----	-----	00	Alc.
2011	Thimble Islands	-----	-----	-----	A. E. Verrill	-----	Alc.
2012	Long Island Sound, Fisher's Island Sound.	7	Sand and shells	—, 1874	U. S. Fish Com.	1	Alc.
2013	Long Island Sound	4½	Sand and gravel.	—, 1874	do	2	Alc.
2014	do	-----	-----	—, 1874	do	1	Alc.
2015	do	-----	-----	Sept. 10, 1874	do	2	Alc.
2016	Noank	-----	Eel-grass	—, 1874	do	2	Alc.
2017	Vineyard Sound	-----	-----	—, 1875	do	2	Alc.

***Erichsonia attenuata* Harger.**

Erichsonia attenuata Harger, This Report, part i, p. 570 (276), pl. vi, fig. 27, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

Verrill, This Report, part i, p. 370 (76), 1874.

PLATES VI and VII, FIGS. 36 and 37.

This species is at once distinguished from the preceding by its slender form and regular outline; the clavate antennal flagellum distinguishes it from other Isopoda.

The body is smooth throughout and about six times as long as broad, without prominent irregularities and narrowly linear in outline. The eyes are small and black. The antennulæ (pl. VII, fig. 37 *a*) are short, slightly surpassing the second antennal segment. The antennæ (pl. VII, fig. 37 *b*) are stout and smoother than in the preceding species. The external lamella of the maxillipeds (pl. VII, fig. 37 *c, l*) is oval and regularly rounded at the tip.

The thoracic segments increase in size to the third, which is equal to the fourth, and the last three are of a gradually decreasing size. The epimera are nowhere conspicuous, but may usually be seen from above, especially in the posterior segments.

The pleon presents only slight traces of a lateral tooth near its base and is but little dilated toward the tip. The operculum (pl. VII, fig. 37 *d*) is longer than in the preceding species, the basal plate is more than three times as long as broad, the terminal plate elongated triangular and obtuse. The male stylet on the second pair of pleopods (pl. VII, fig. 37 *e, s*) is nearly straight, hardly surpasses the cilia, and is minutely denticulated near the acute apex.

Length 15^{mm}; breadth 2.5^{mm}. Alcoholic specimens are of a light grayish yellow, with minute black punctations.

It was abundant in eel-grass at Great Egg Harbor, New Jersey! in April, 1871, and has also been found at Noank, Conn. on eel-grass, but is not common. It has not been found north of Cape Cod.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
1226	Great Egg Harbor, N. J.	.....	Eel-grass	Apr. —, 1871	S. I. Smith.....	00	.....	Alc.
2018	Noank, Conn. ....	.....	do	— —, 1874	U. S. Fish Com.	1	♀	Alc.

Epelys Dana.

Epelys Dana, Am. Jour. Sci., II, vol. viii, p. 426, 1849.

Antennæ shorter than the antennulæ and with only a rudimentary flagellum; palpus of the maxillipeds three-jointed; legs all terminated with prehensile hands; pleon consolidated into a single segment with a basal lobe on each side.

Two small and closely allied species from this coast have been referred to this genus. They resemble each other very closely and may be at once recognized by their depressed ovate form, very short antennæ, and generally dirty appearance. The form of the body and absence of powerful mandibles distinguish them from the male *Gnathia*. The length of the body is between two and three times its width. It is marked by a depressed line on each side, running from the posterior part of the head, across the thoracic segments, nearer to their lateral margins than the median line, except perhaps in the last segment, thence continued to inclose a prominent hemispherical protuberance on the anterior part of the pleon, giving the animal somewhat the appearance of a trilobite. The body is slightly roughened under a lens, or sometimes minutely hirsute. The head is slightly dilated at the sides, with the anterior angles produced, and bears a pair of broad, low, triangular tubercles on its anterior part, and a curved posterior depression. The eyes are lateral and prominent, the antennulæ are longer than the head, surpass the antennæ, and have the basal segment but little enlarged. The antennæ (pl. VIII, fig. 45 b) are shorter than the head, not surpassing the third antennular segment, the segments increasing in length to the fourth; fifth as long as the fourth, but more slender, bearing a minute, slender rudiment of a flagellum, which is setose at the tip.

The thoracic segments have thick evident margins; first segment smallest, somewhat embracing the head; third and fourth largest;

last segment curving around the base of the pleon. The epimera are not evident from above. The legs (pl. VIII, fig. 46 *a*) are slender and all terminated by a slender prehensile hand, of which the finger, or dactylus, becomes almost acicular in some of the posterior pairs. All the legs are more or less hairy.

The pleon bears on each side, near its base, a rounded lobe, which is separated from the large posterior portion by a more or less evident incision. Dorsally it is convex, and presents two hemispherical elevations, the proximal more convex than, but only half as large as, the distal. They are separated by a broad and deep groove, and the distal convexity is continued upon the obtusely-pointed apex of the pleon. The operculum (pl. VIII, fig. 46 *b*) is vaulted; its basal plate is rounded anteriorly, carinate near its inner margin, contracted externally for the distal third of its length and truncate at the tip, where it bears a stout elongated-triangular finely ciliated terminal piece. The basal plate is coarsely ciliated on its inner margin, and bears a few plumose hairs along its outer free margin. The stylet on the second pair of pleopods in the males is short and stout, surpasses the lamella but not the cilia, and is spinulose just below the blunt apex.

Both species are of a dull neutral color, and commonly covered with particles of mud or other foreign matter. They occur on piles, or under stones, in muddy places, and are dredged on muddy bottoms.

***Epelys trilobus* Smith (Say).**

Idotea triloba Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 425, 1818.

Edwards, Hist. nat. des Crust., tome iii, p. 134, 1840.

Decay, Zool. New York, Crust., p. 43, 1844.

Leidy, Jour. Acad. Nat. Sci., II, vol. iii, p. 150, 1855.

Jaera? *triloba* White, List Crust. Brit. Mus., p. 97, 1847.

Epelys trilobus Smith, This Report, part i, p. 571 (277), pl. vi, fig. 28, 1874.

Verrill, Am. Jour. Sci., III, vol. vii, p. 135, 1874; Proc. Amer. Assoc., 1873, p. 372, 1874; This Report, part i, p. 370 (76), 1874.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 160, 1879.

PLATE VII, FIGS. 42 and 43.

This species may be recognized among our Isopoda by its appearance when seen from above, recalling the form of the trilobites, the flattened dorsal surface being marked, as in those animals, by two lateral longitudinal depressions. The pleon is consolidated into a single piece and the antennæ have only a rudimentary flagellum. It closely resembles the next species, but is smaller and most readily distinguished by the lateral margin of the thorax, which is, especially in the anterior part, nearly even instead of zigzag from the projecting angular segments. The anterior angles of the head are also less produced.

The pleon is shorter and broader, its breadth being to its length as six to ten. The deep transverse groove across the pleon is continued to the margin, with only, at the most, traces of a tubercle at each side. The stylet on the second pair of pleopods of the male (pl. VII, fig. 42 *b*,

s, and s'), is a little less elongated than in the next species, not attaining the middle of the cilia.

Length 6^{mm}; breadth 2.3^{mm}. The color is uniform, dull, usually obscured by the adhering particles of dirt.

This species was described by Say from Egg Harbor!, New Jersey, where specimens were also collected by Professors Verrill and Smith, in April, 1871, among eel-grass. It has also been found at Savin Rock!, near New Haven, and Noank Harbor!, on piles and among eel-grass; at Vineyard Sound!; Mass., at Provincetown!, Mass., near Cape Cod in 1879; sparingly near Gloucester! Mass., in 1878, and even as far north as Quahog Bay!, about thirty miles northeast of Portland, Me., where it was taken by the United States Fish Commission, in 1873, along with *Venus mercenaria* and other southern forms.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
1227	Great Egg Harbor, N. J.	.....	Eel-grass	Apr. —, 1871	S. I. Smith.	7	Alc.
2019	Savin Rock, New Haven.	L. w.	.....	1871-1872	A. E. Verrill ..	2	Alc.
2020	Noank Harbor .....	.....	.....	Aug. 12, 1874	U. S. Fish Com.	12	Alc.
2021	do	Sf.	.....	July 13, 1874	do	7	Alc.
2022	do .....	.....	On piles	July 27, 1874	do	1	Alc.
2023	do .....	.....	Eel-grass	—, 1874	do	00	Alc.
2024	Watch Hill, R. I.	.....	.....	Apr. —, 1873	A. E. Verrill ..	4	Alc.
2025	Vineyard Sound .....	.....	.....	—, 1871	U. S. Fish Com.	2	Alc.
2026	do .....	.....	.....	—, 1871	do	1	Alc.
2027	do	L. w.	Sand	—, 1871	do	2	Alc.
	Provincetown, Mass.	L. w.	.....	Aug. —, 1879	U. S. Fish Com.	2	Alc.
	do	½	Eel-grass	—, 1879	do	1	Alc.
	do .....	.....	Shore	—, 1879	do	9	Alc.
	Gloucester, Mass.	.....	Tide-pools	—, 1878	do	2	Alc.
2028	Quahog Bay, Me.	L. w.	Muddy	—, 1878	do	3	Alc.

***Epelys montosus* Harger (Stimpson).**

Idotea montosa Stimpson, Mar. Inv. G. Manan, p. 40, 1853.

Epelys montosus Harger, This Report, part i, p. 571 (277), 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

Verrill, Am. Jour. Sci., III, vol. vii, p. 45, 1874; Proc. Amer. Assoc., 1873, p. 367, 1874; This Report, part i, p. 370 (76), 1874.

Smith and Harger, Trans. Conn. Acad., vol. iii, p. 3, 1874.

Whiteaves, Further Deep-sea Dredging, Gulf St. Lawrence, p. 15, "1874."

PLATE VIII, FIGS. 44-47.

This species closely resembles the preceding, and may be recognized among our Isopoda by the characters mentioned under the former species, from which it is distinguished by the following characters: The eyes are prominent; the anterior angles of the head salient. The tubercles on the head are more prominent than in the former species. The lateral margins of the thoracic segments, especially the second, third, and fourth, are angulated and salient. The pleon is more elongated

than in the last species, its breadth being to its length as 5.5 to 10, and the depression crossing it is partially interrupted at each side by a tubercle which often projects, as seen from above, just behind the basal lobe, forming a shoulder to the large terminal lobe. The stylet on the second pair of pleopods in the males (pl. VIII, fig. 47, *s* and *s'*) attains about the middle of the cilia.

Length 10^{mm}; breadth 4^{mm}; color, as in the preceding, dull, and usually much obscured by adhering dirt.

A few specimens were collected in Whiting River, near Eastport, Maine, in 1872, which are much more decidedly hirsute than is usual, both on the upper surface and on the legs as well. In other respects they appear to be referable to this species, although the posterior thoracic segments are rather less angulated at the lateral margin. They may be worthy of a variety name *hirsutus*.

Dr. Stimpson's specimens were "taken in deep water on sandy and muddy bottoms" in the Bay of Fundy, and this species usually replaces the last in the northern localities. It has, however, been taken as far south as Block Island Sound!, near the eastern end of Long Island Sound, in 18 fathoms, sandy bottom, and in 29 fathoms Vineyard Sound!. North of Cape Cod it is more common. It was dredged in 25 fathoms on St. George's Bank!, at Stellwagen's Bank! in 20 to 40 fathoms, rocky and sandy bottom; Casco Bay!, 16 to 17 fathoms mud; Bay of Fundy!, at many localities, usually on muddy bottoms, and in 16-18 fathoms mud and stones; off Halifax!, Nova Scotia, by the Fish Commission, and in 14 fathoms off Richibucto, in the Gulf of Saint Lawrence, by Mr. J. F. Whiteaves. The greatest depth positively recorded is 29 fathoms, but it may very likely have come also from a depth of 40 fathoms near Stellwagen's Bank.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2029	Vineyard Sound	29	.....	Sept. 14, 1871	U. S. Fish Com.	8	Alc.
2030	Block Island Sound	18	Sand	—, 1874	do	1	Alc.
	Off Boston Harbor	16	Speckled sand, shells.	Sept. 13, 1879	do	2	Alc.
	Gloucester Harbor, Mass.	7-8½	do	—, 1878	do	30	Alc.
2032	George's Bank	25	.....	—, 1872	.....	2	Alc.
2031	Stellwagen's Bank	20-40	Rocks and sand	—, 1873	A. S. Packard.	1	Alc.
2033	Casco Bay	16	Mud	July 12, 1878	U. S. Fish Com.	00	Alc.
2035	do	17	do	Aug. 30, 1873	do	00	Alc.
	do .....	.....	.....	—, 1873	do	00	Alc.
2038	Bay of Fundy, Eastport.	.....	.....	—, 1872	do	6	Alc.
2039	do .....	.....	.....	—, 1872	do	2	Alc.
2040	Bay of Fundy, Whiting R.	2	Mud	—, 1872	do	6	Alc.
2041	Seal Cove, Grand Menan.	8-10	.....	—, 1872	do	10	Alc.
2042	Off Halifax, N. S.	16	Stones, sand, red algæ.	—, 1877	do	4	Alc.
2043	do	18	Mud, fine sand ..	Sept. 15, 1877	do	2	Alc.

VI.—ARCTURIDÆ

Form elongated; antennæ large and strong; first four pairs of legs directed forward, ciliated, last three pairs ambulatory; segments of pleon more or less consolidated; uropods operculiform.

This well marked family is as yet represented on our coast by a single species of the genus *Astacilla* Fleming, *Leachia* or *Leacia* of Johnston and other authors. The family can be easily recognized by the four anterior pairs of legs, which are directed forward and strongly ciliated on their inner margins with long slender hairs. The form of the body is elongate and may be very much so, as in our species the length of the body in the male is twenty times as great as its diameter at the middle; in the female eight times. The head is of moderate size and the eyes prominent. The four-jointed antennulæ have the basal segment large and swollen. The antennæ are large and powerful organs, approaching or even surpassing the body in length, with the first two segments short, the second deeply incised below as in *Idotea*, the next three segments elongated, and the flagellum varying in the genera, being multiarticulate in *Arcturus*, and composed of not more than four segments in *Astacilla*. The mouth parts resemble, in general, those of the *Idoteidæ*. The fourth thoracic segment is more or less elongated. The last three pairs of legs are ambulatory, differing much from the first four pairs. The segments of the pleon are more or less united, and the uropods are modified, as in the preceding family, to form an operculum for the more delicate anterior pleopods. They are wholly inferior, and consist on each side of a large basal segment, straight on the median line, where it meets its fellow of the opposite side, and bearing, in our genus, two small terminal plates at the apex.

This structure of the pleon and its appendages, together with the structure of the antennulæ, antennæ, and the parts of the mouth, point to a close relationship between this family and the *Idoteidæ*. With the *Anthuridæ*, however, with which they have often been associated, they seem to have little in common, except, perhaps, the elongate form of body. Even this feature is approached also in the *Idoteidæ*, in *Erichsonia*, for example.

***Astacilla* Fleming.**

Leacia (*Leachia*) Johnston, Ed. Phil. Jour., vol. xiii, p. 219, 1825 (*non* Lesueur).

Astacilla Fleming, Encyc. Brit., 7th ed., vol. vii, p. 502.

Johnston, Loud. Mag. Nat. Hist., vol. viii, p. 494, 1835.

Antennal flagellum short, not more than four-jointed; fourth thoracic segment elongated, and, in the females, bearing the incubatory pouch on its inferior surface.

The characters given above seem sufficient to warrant the separation of this genus from *Arcturus*, notwithstanding the fact that the young of some species, and probably of all, have the fourth thoracic seg-

ment no longer than the others as noticed by Johnston*, and later by Stebbing†, who draws from the fact an argument against the validity of the genus. I fail to see, however, why the argument would not be equally valid against the use, among mammals, of characters drawn from the horns and teeth. Nothing is more common, in case of a genus or family possessing a special development of some organ or set of organs, than to find that the young of such a group resemble the adults of less specialized groups. If, however, as may be possible, a gradation can be established between forms which, like *Arcturus Baffini*, have the fourth thoracic segment large but only slightly elongated, and forms like *Astacilla longicornis* or *A. granulata*, in which this segment is much elongated, equaling or surpassing the other six in length, there would then be, perhaps, no sufficient reason for retaining both genera. For the present it seems desirable to keep them separate, and to the characters given above we may add the following:

The head is produced at the sides around the bases of the antennulæ, and is united dorsally with the first thoracic segment, the sutures being evident only at the sides where the segment is produced around the hinder part of the head. The flagellum of the antennæ consists of three, or sometimes only two, distinct segments and a terminal spine, which is perhaps to be regarded as a third or fourth segment. The maxillipeds (pl. IX, fig. 52 *a*) are robust and operculiform, with a thick external lamella and a five-jointed palpus, but little flattened. The mandibles are destitute of palpi.

The first three thoracic segments are subequal and short; the fourth much elongated in both sexes; in the males it is slender and cylindrical; in the females it is more robust, and bears on its inferior surface the incubatory pouch. This pouch is thus confined to a single segment, and is composed of a pair of elongated lamellæ, attached along their outer margins, and overlapping widely along the ventral surface. It occupies nearly the entire inferior surface of the segment. The last three thoracic segments are short and subequal, and the articulation at the posterior end of the fourth segment is capable of considerable motion, and, in our species, is usually flexed backward nearly at a right angle. The first pair of legs (pl. VIII, fig. 49 *b*) have the basis directed backward and the remaining segments ciliated and turned forward, and is more robust than the three succeeding pairs, which are slender, of nearly equal size, and consist of only five segments, which are turned forward from the basis and held beneath the head. They are strongly ciliated, especially on the last three segments. One of the fourth pair of legs is shown on plate VIII, figure 50. The last three pairs of legs are of entirely different structure, being robust and prehensile with strong short dactyli.

The pleon is consolidated into a single segment, which, however, shows traces of its composite nature. It is vaulted above and excavated on

* Loud. Mag. Nat. Hist., vol. ix, p. 81, fig. 15, 1836.

† Ann. Mag. Nat. Hist., IV, vol. xv, p. 187, 1875.,

its inferior surface for the delicate pleopods, which are protected by the operculiform uropods. Both rami of the uropods are present in our species, but the outer is much the larger and conceals the delicate inner ramus in an exterior view. The outer ramus only is thickened and of functional importance as an operculum.

The habits of these animals are described by Goodsir in the Edinburgh New Philosophical Journal, vol. xxxi, p. 311. He says, "With the dredge I have procured specimens * * * * alive, and have kept them in glass jars of sea-water with sand and corallines, and have thus been enabled to watch their habits closely.

"Under the circumstances just stated, each individual will select a branch of coralline, will keep that branch exclusively to itself, and will defend it with the greatest vigor against all intruders. It fixes itself to its resting-place by means of its true thoracic feet, and seldom uses these for progression. When it falls to the bottom of the vessel, it fixes its long pointed antennæ firmly into the sand, and, with the assistance of the true feet, drags and pushes itself forward. This, however, may not be a natural mode of progression, but may be adopted in consequence of the artificial circumstances in which the animal is placed.

"Swimming is the natural mode of progression. It is amusing to see one of these animals resting, in an erect posture, on a branch of coralline, by means of its true thoracic feet, waving its body backwards and forwards, throwing about its long inferior antennæ, and ever and anon drawing them through its anterior fringed feet, for the purpose of cleaning them. It frequently darts from its branch, with the rapidity of lightning, to seize with its long antennæ some minute crustaceous animal, and returns to its resting-place to devour its prey at pleasure.

"In this manner the antennæ are the only organs employed in seizing and enclosing the prey, which they drag to the anterior thoracic feet, which hold it while it is being devoured."

I have discarded Johnston's name *Leachia*, or according to his orthography *Leacia*, proposed in 1825, as being preoccupied by Lesueur,* in the Mollusca in 1821. *Astacilla* is used by Fleming in the 7th edition of the Encyclopædia Britannica; 1842 is given as the date in the copy of the seventh volume of the Encyclopædia that I have seen, but Johnston refers to Fleming in 1835 as authority for the name, quoting the Encyclopædia. Fleming says in the Encyclopædia (vol. vii, p. 502): "The genus was instituted by the Rev. Charles Cordiner of Banff in 1784 for the reception of a British species which has been denominated *Astacilla longicornis*." I have not been able to find whether Cordiner published the name at that early date or whether it was a manuscript name only. If actually published in 1784 it would have many years' priority over *Arcturus*, and the author who would unite the genera should use the name *Astacilla*. Even if not published until 1835 it appears to have the best claim to recognition as the generic name of the type here treated of.

* Jour. Acad. Nat. Sci. Phila., vol. ii, p. 89, 1821.

Astacilla granulata* Harger (G. O. Sars).Leachia granulata* G. O. Sars, Arch. Math. Nat., B. ii, p. 351 [251], 1877.*Astacilla Americana* Harger, Am. Jour. Sci., III, vol. xv, p. 374, 1878.*Astacilla granulata* Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879

PLATES VIII AND IX, FIGS. 48-52.

The elongated fourth thoracic segment distinguishes this species at once from all the other Isopoda of our coast.

The body is in the female eight times and in the male about twenty times as long as broad, the breadth being measured across the fourth thoracic segment. It is roughened and tuberculated throughout. The head is produced at the sides in front beyond the middle of the basal segment of the antennulæ, and is tuberculated above and crossed by two transverse grooves, the first between, and the second behind the eyes, while a third similar groove evidently marks the place of the suture between the head and the first thoracic segment. The eyes are lateral, prominent, round-ovate, broadest in front. The antennulæ in the female slightly surpass the second segment of the antennæ, in the male they nearly attain the middle of the third segment, the flagellar segment being elongated in the male, longer than the three peduncular segments together (pl. VIII, fig. 48 *a*). The second and third segments of the antennulæ are in both sexes short and slender. The antennæ are fully three-fourths as long as the body; the first segment is shorter than that of the antennulæ, being surpassed at the sides by the lateral processes of the head and thus concealed in a lateral view; the second segment is large, scarcely longer than broad, and presents below a deep angular sinus in the distal margin, as in *Idotea*; third segment about as long as the head; fourth segment longest, slightly exceeding the fifth, which is equal to the first three taken together. The flagellum* (pl. VIII, fig. 49 *a*) is less than half the length of the last peduncular segment and usually consists of three distinct segments, of which the first is as long as the other two; the second is equal in length to the third, which is tipped with a terminal spine or claw, probably to be regarded as a fourth segment. Sometimes, however, only two distinct segments exist in the flagellum besides the claw. The flagellar segments are finely and sharply denticulate along the margin which is inferior when the antennæ are straightened. The character of this denticulation is shown in figure 49 *a'* on plate VIII, where a small section of the margin is shown enlarged 100 diameters. The maxillipeds (pl. IX, fig. 52 *a*) are robust and cover the other parts of the mouth; the external lamella (*l*) is ovate and in the figure is somewhat bent outward from its natural position. The palpus of the maxillipeds is five-jointed and but little flattened, strongly ciliated along the inner margin. The terminal lobe

* The figure of the animal (pl. VIII, fig. 48,) was sent to the engraver before I had seen any specimens except the imperfect ones collected in 1877, and the flagellum of the antennæ was dotted from the young specimens. Fig. 49 *a* on plate VIII was made from a specimen obtained in 1878.

(pl. IX, fig. 52 *a*, *m'*) is quadrate, scarcely ciliated at the apex, and distinctly articulated with the maxilliped. The outer maxillæ (pl. IX, fig. 52 *b*) are three-lobed and strongly ciliated. The inner maxillæ (pl. IX, fig. 52 *c*) are two-lobed, the lobes robust and short, the outer armed with short spines at the apex, the inner with three slender curved setæ.

The thoracic segments are coarsely granulated or tuberculated; the first is produced at the sides around the head nearly to the eyes; the others have their anterior and posterior margins transverse. The fourth segment in the female is a little less than three times as long as broad, and is longer than the other six segments taken together, but is only four-fifths as long as the last three segments together with the pleon. It is tuberculated, especially above, but bears no prominent tubercles or spines, and is subcylindrical. In the male this segment (pl. VIII, fig. 48 *b*) is more elongate and much more slender, exceeding in length the three following segments with the pleon. In the ordinary position the thorax is geniculate at the posterior articulation of the fourth segment, forming nearly a right angle with the rest of the body. The last three segments have their epimeral regions angulated and salient. The first pair of legs (pl. VIII, fig. 49 *b*) are of moderate length and, beyond the basal segment, flattened; the basal segment is directed backward but the leg is bent upon itself at the ischium and the remaining segments are directed forward and applied to the under surface of the head. The ischium and merus support but few cilia, and these mostly along their inner margins, but the carpus, propodus, and dactylus are not only ciliated on the inner margin with slender simple cilia, but also bear on the side toward the body stout scattered spinulose setæ, which are specially abundant on the propodus. The opposite side of the leg is nearly smooth. The second, third, and fourth pairs of legs are five-jointed and similar to each other, except that the basal segments of the second and third are somewhat shorter than in the fourth (pl. VIII, fig. 50). The second pair is shorter than the third, and the fourth is a little the longest. All these legs are directed strongly forward and habitually held nearly in the position shown in the figure, under the anterior surface of the body and the head. The last three segments are furnished with elongated setæ along their inner margins. These setæ are inserted in two rows and so placed as to diverge at an open angle. The dactyli appear to be obsolete in these legs. The fifth, sixth, and seventh pairs of legs are of quite a different and more ordinary structure. They contain the full number of segments, and are terminated by robust, slightly curved dactyli. A young specimen obtained has only two pairs of legs of the ordinary form, the last or seventh pair being represented only by rounded tubercles, one on each side of the seventh segment.

The pleon is elongate-ovate, narrower in the male (pl. VIII, fig. 48 *c*). Dorsally it is strongly convex, especially in front. It is two-thirds as long as the fourth thoracic segment in the female, and three-fifths as

long as that segment in the male. It is provided with rather coarse tubercles in front, which are arranged transversely in three rows, and behind the third row is a deep transverse groove, behind which the tubercles are less prominent and more of the character of granulations. On each side before the middle is a prominent, sub-acute tooth, directed outward and backward immediately above the articulation of the uropods. The tip of the pleon is not spiniform, but only slightly attenuated and obtuse. The pleopods are delicate in structure, and the anterior pairs are ciliated. The uropods or opercula are more than nine-tenths as long as the under surface of the pleon (pl. VIII, fig. 48 c), but cannot be seen from above. They consist on each side (pl. VIII, fig. 51) of an elongated, semi-oval, basal, lamellar segment, thickened and vaulted externally, with the anterior end rounded, and bearing a salient semi-circular process on the outer margin near the anterior end, for articulation with the pleon. Posteriorly this plate is tapering and it is broadly truncated at the tip, where it bears two lamelliform rami. Of these the external is thick, like the basal segment, and is of an elongate triangular form and completes the operculum behind, while the inner ramus is a small and delicate oval plate, articulated to the basal segment near its inner distal angle, and completely covered and concealed by the outer ramus when the operculum is closed. The inner ramus is sparingly ciliated at the tip. The pleopods are very delicate, and the anterior pairs are ciliated.

In the females the lamellæ forming the incubatory pouch are thickened and tuberculated or granulated along the outer edge where they are attached to the segment. The thickened area is bounded by a longitudinal ridge, beyond which the lamella is thin, smooth, and translucent, permitting the eggs to be seen through it, and the thin portion of the right lamella (in the specimen examined) overlaps its fellow of the opposite side so far as to bring its edge along the base of the ridge bounding the thickened portion of the opposite lamella. Near the anterior end and on the outer side is a rounded lobe in the margin of the lamella for articulation with the segment.

Length of female 10^{mm}; male 11^{mm}; diameter of fourth thoracic segment, female 1.2^{mm}; male 0.52^{mm}; color in alcohol, nearly white.

This species was described by the writer without having seen Sars' description of *Leachia granulata*. The volume containing his description has since been obtained by the Yale College Library, and a careful comparison of our specimens with his description leaves little doubt that the species is identical with his. His specimens were somewhat larger than ours, females measuring 14^{mm} and males 17^{mm}. The females in *A. longicornis* Sowerby are much larger than the males, and the reverse relation of size in this species appears to be unusual in the genus.

Specimens were first collected on this coast on George's Bank!, in the summer of 1877, and the three then obtained were found adhering to *Primnoa*, and had been dried and somewhat broken. Better specimens were collected adhering to the cable of the schooner 'Marion,' at Ban-

quereau!, by Capt. J. W. Collins, August 25, 1878, and a fine specimen was obtained in seven fathoms off Miquelon Island!, south of Newfoundland, by Capt. C. D. Murphy and crew of the schooner 'Alice M. Williams,' July 3, 1879. Sars' specimens were collected between Norway and Iceland at stations 18 and 48, of which the respective localities as given by him are latitude $62^{\circ} 44.5'$ north, longitude $1^{\circ} 48'$ east, in 412 fathoms, clayey bottom, and latitude $64^{\circ} 36'$ north, longitude $10^{\circ} 21.5'$ west, in 299 fathoms, clay and sand.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alo.
						No.	Sex.	
2045	George's Bank.....	-----	-----	—, 1877	U. S. Fish Com.	2	♀ y	Alo.
2046	do	-----	-----	—, 1877	do	1	♂	Alo.
	Banquereau, N. S....	250	Rocky	—, 1878	Capt. J. W. Collins.	3	♀	Alo.
	Off Miquelon Island.	7	-----	July 3, 1879	Capt. C. D. Murphy and crew.	1	♀	Alo.

VII.—SPHÆROMIDÆ.

Body short and convex; head transverse; antennulæ and antennæ multiarticulate, with evident distinction into peduncle and flagellum; mandibles palpigerous; epimera united with the thoracic segments; anterior segments of the pleon short, united and articulated with the large terminal segment; uropods lateral with only one movable ramus.

This family is sparingly represented on the eastern coast of the United States, and within our limits only a single species is found, belonging to the typical genus *Sphæroma*. The animals are usually of small size, and have the body short, broad, and convex. The head is transverse, and both pairs of antennæ are inserted near together below its anterior margin. These organs are much better developed than in the following family. The epimera are faintly indicated in the thoracic segments by impressed lines. The anterior segment of the pleon is similarly marked with transverse sutures indicating the segments of which it is composed. The last segment is large, and one or more of the posterior segments may be notched, tuberculated, spiny, or variously modified, as occurs in many foreign genera. Below, the pleon is much excavated for the pleopods, which, as usual, are in five pairs, the anterior three ciliated. In the males a slender stylet is articulated near the base of the inner lamella of the second pair, and lies along its inner side, so that in the natural position they lie close together on opposite sides of the middle line of the body. These pleopods, though received into a cavity in the under surface of the pleon, are not protected by any operculum nor opercular plates, as in most of the preceding families, nor is the external pair thickened, as in the *Anthuridæ*.

Sphæroma Latreille.

Sphæroma Latreille, Hist. nat. des Crust. et des Ins., tome vii, p. 11, 1804.

Body contractile into a sphere; antennulæ and antennæ short or of moderate length; maxillipeds with a five-jointed palpus; legs all ambulatory; dactyli short and thick; uropods short, ramus and basal segment subequal.

The name of this genus is derived from the peculiar habit of many of the species of rolling themselves into a ball when alarmed. The body is so constructed as to facilitate this operation, the antennulæ and antennæ being received into a groove at the side of the head; the epimeral regions of the thoracic segments behind the first are narrowed nearly to a point and project well downward so as to meet very close together and still leave room for the included legs, while the uropods, shutting together like a pair of scissors, fold also partly under the large terminal segment of the pleon and fill the crevice between the pleon and the head. The maxillipeds in this genus are provided with a long densely ciliated five-jointed palpus. The maxillæ are much as in the *Idoteidæ*, the outer pair three-lobed and strongly ciliated, the inner two-lobed with the inner lobe small and tipped with pectinate setæ, the outer larger and armed with curved denticulated spines. The mandibles have a strong molar process, a dentigerous lamella armed with acute teeth, and a three-jointed palpus.

The legs are rather weak and nearly alike throughout, all ambulatory. The pleon is scarcely narrower than the segments of the thorax and appears to consist of two* segments only, of which the first is much like the last thoracic segment, but more strongly produced at the sides than is that segment and marked with impressed lines. It is articulated with considerable motion to the large scutiform terminal segment, which, in this genus, is rounded and entire at the tip, and not strongly tuberculated nor spiny. Anteriorly, the angles of this segment are produced downward into a rounded lobe in front of the shoulder from which arise the uropods. These organs are not greatly elongated; the basal segment is produced into a plate about equal in size to the single ramus.

Sphæroma quadridentatum Say.

Sphæroma quadridentata Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 400, 1818.

Dekay, Zool. New York, Crust., p. 44, 1844.

White, List Crust. Brit. Mus., p. 102, 1847.

Harger, Am. Jour. Sci., III, v., p. 314, 1873; This Report, part i, p. 569 (275), pl. v., fig. 21, 1874; Proc. U.S. Nat. Museum, 1879, vol. ii, p. 161, 1879.

Verrill, This Report, part i, p. 315 (21), 1874.

PLATE IX, FIG. 53.

The outline of the body when extended is a pretty regular ellipse, but the animal, when disturbed, rolls itself into a ball with facility, and by

* The pleon is inadvertently described by Bate and Westwood in the British Sessile-Eyed Crustacea, vol. ii, p. 401, as "having all the segments fused together."

this habit may be distinguished from the other marine Isopods of our coast.

The head is rounded in front with an elevated margin, and a slight median projection between the bases of the antennulæ. The eyes are small and sub-triangular, widely separated. The antennulæ and the antennæ are inserted on the inferior surface of the head, and, when the animal contracts, they are received into a groove along the margin of the head and anterior thoracic segment. The antennulæ (pl. IX, fig. 54*a*) have the basal segment large, the second segment small and conical, the third slender, cylindrical; the flagellum about ten-jointed, ciliated, shorter than the peduncle. In the antennæ (pl. IX, fig. 54*b*) the peduncular segments decrease but little in diameter, and increase in length from the first to the fifth, and are followed by a flagellum about as long as the peduncle, tapering from the base, with the basal segments strongly ciliated along their inner or anterior distal margins. The antennæ are separated at the base by a triangular, somewhat projecting epistome, which also partly separates the bases of the antennulæ. The maxillipeds have the basal segment short and somewhat triangular, with plumose setæ at the acute apex, and a five-jointed palpus, of which the first segment is short and smooth, and the following segments strongly ciliated along more or less of their inner margins. The outer maxillæ are terminated by three ovate rather acute lobes, which are strongly ciliated. The inner maxillæ have the inner lobe tipped with four pectinated curved setæ, and the outer armed with strong denticulated spines. The mandibles are robust and bear on their external surface at the apex a dentigerous lamella, or usually two such on the right mandible, receiving the lamella of the left between them; below the lamella is a strongly ciliated ridge supporting the dentigerous lamella and connecting it with the molar process, which is large and strong. The mandibular palpi are slender, with the last segment sub-semicircular, bearing at its apex a few serrated spines, and below a comb of straight setæ; the middle segment bears a similar comb with stouter spiny setæ at the ends.

The first thoracic segment is longer than the others, and much elongated at the sides, embracing the head as far as its anterior margin. Above this lateral expansion on each side the segment is excavated for a projecting lobe of the head behind the eye. The second, third, and fourth segments are somewhat shorter than the first and longer than the fifth, sixth, and seventh. The margin of the last segment bends slightly backward at the middle. In the thoracic segments behind the first the epimeral sutures are indicated by a faint depressed line, below which the lateral margin of the second segment tapers to an obtusely rounded point, the third is more acutely pointed, the fourth oblique and acute behind, the fifth and sixth also oblique but less acute, and the seventh rounded. The legs are weak, hairy, and much alike throughout, formed for walking, and none of them chelate. The dactylus in all is short and robust, armed with a stout curved spine or claw at the tip, and a smaller

straight spine below it. In the first pair of legs the carpus is short and triangular, the ischium and merus bear on their upper margin a row of long slender plumose hairs. In the second and third pairs of legs these hairs are also found, and the carpus is longer. The fourth pair of legs are robust, the following pairs more slender to the seventh. All are well provided with slender hairs, with a few stouter ones intermixed.

The anterior segments of the pleon are consolidated into a single piece somewhat resembling the last thoracic segment, but marked at the sides by depressed lines, indicating sutures, as shown in pl. IX, fig. 53. At the sides this segment is broadly rounded and projects much below the seventh thoracic when the animal is contracted. The large terminal segment has a similar lobe in front of the bases of the uropods. At the insertion of the uropods the segment is considerably contracted laterally, but is rounded and strongly margined behind. Its anterior lobe, all the thoracic segments, and the head are also margined by an elevation running completely around the animal except where it is interrupted by the uropods. The uropods extend nearly to the tip of the telson, and consist on each side of a basal segment continued backward into a narrow oval plate with entire margins, flattened below, where a similarly-shaped ramus is articulated near its base, the two shutting together like the blades of a pair of scissors. The articulated plate bears four more or less acute serrations on its exterior margin, whence the specific name. The pleopods are ciliated, and the second pair (pl. IX, fig. 54c) bears, in the male, on the inner lamella, a slender curved stylet, longer than the lamella, and articulated near its base.

Length about 8^{mm}, breadth 4^{mm}. The color, as usual in shore species, is variable; some are of a uniform slaty gray, many are marked on the dorsal surface with a whitish, cream color, or rosaceous patch, bordered more or less with dark or black. This patch has commonly a longitudinal direction, and is usually symmetrical, and may be broad or much narrowed in the middle. On the dark or barnacle-covered rocks, where these animals are often found, the colors are evidently protective, but they are imperfectly preserved in alcohol.

This species was described by Say, who "found these animals very numerous on the beach of Saint Catherine's Island, Georgia, concealing themselves under the raised bark, and in the deserted holes of the *Teredo*, &c., of such dead trees as are periodically immersed." He also gives East Florida as a locality, and there are specimens in the Yale Museum from Florida! It extends as far north as Provincetown, Mass.! near the extremity of Cape Cod. It is common on the southern shore of New England!, and is usually found among algæ or rocks.

Specimens examined. *

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2054	Florida .....		.....		Smithsonian Inst.	00	Alc.
1224	Great Egg Harbor, N. J.			April, 1871	Smith & Verrill		Alc.
2053	New Haven, Conn.				S. I. Smith.	5	Alc.
	Savin Rock, New Haven	L. w.	Rocky			00	Alc.
2052	Stony Creek, Conn.	L. w.	Rocky			00	Alc.
2049	Vineyard Sound, Mass.			—, 1871	U. S. Fish Com.	3	Alc.
2050	do	L. w.		—, 1871	do	1	Alc.
2051	do			—, 1875	do	5	Alc.
	Provincetown, Mass.	L. w.		Aug., 1879	do	00	Alc.
	do	$\frac{1}{2}$	Hel-grass	Aug., 1879	do	1	Alc.

VIII.—LIMNORIIDÆ.

Body compressed; antennulæ and antennæ short, subequal; mandibles palpigerous, formed for gnawing; feet not prehensile, all similar, with short, robust dactyli; epimera united with the thoracic segments; pleon of six distinct segments; pleopods similar in form throughout; uropods lateral, biramous.

This family as constituted above contains the single genus *Limnoria* Leach, which appears also to contain but few, or perhaps a single, species* of wide distribution. This genus was placed in the tribe *Asellotes homopodes* with the *Asellidæ* by Edwards, without, however, having examined the animals himself. He has been generally followed in this arrangement by later authors. Previous authors had associated the genus, as it appears to me more justly, with *Sphæroma* and the *Oymothoidæ* in the wide signification of the latter term. White, in his List of British Crustacea, used the name *Limnoriadæ* to include this genus with the *Asellidæ*. I have preferred to constitute a new family for the genus, which has, however, evident relations with the *Sphæromidæ*, and perhaps should yet be united with that family.

Under the circumstances family characters can scarcely be separated with certainty from those of generic or even of specific value only, but for the purpose of comparison with other families certain important characters may be here stated. The body is somewhat depressed dorsally, but is also compressed at the sides, and when extended is subvermiform. It is nearly capable of being rolled into a ball, as in the genus *Sphæroma*. The head is of moderate size and strongly rounded above, as in *Sphæroma*, and the eyes are widely separated and on the sides of the head, a condition not usual in the *Asellidæ*. The antennulæ are short and stout and the basal segment is but little larger than the second; the flagellum

* It is perhaps hardly necessary to remark that *L. xylophaga* Hesse, Ann. Sci. nat., tome x, p. 101, pl. ix, 1868, is not an Isopod. According to Prof. Smith it is *Chelura terebrans* Phillipi, a boring amphipod often found associated with *Limnoria*. See an article by that author in the Proceedings of the U. S. National Museum, 1879, vol. ii, pp. 232-235.

consists of a single, almost rudimentary segment. The antennæ differ widely from any in the *Asellidæ*, since they are less robust than the antennulæ, and but little longer; the peduncular segments are all short, having almost the same proportion to each other as in *Sphæroma* (see pl. IX, figs. 54 *b* and 56 *b*), the last two being together about equal in length to the first three, instead of far surpassing them as in the *Asellidæ*; the flagellum is short and few-jointed, mostly made up of a tapering basal segment, and not at all resembling the slender multiarticulate flagellum of the *Asellidæ*. The mandibles are adaptively modified in accordance with the boring habits of the species, but the other mouth parts do not seem to present characters from which comparisons need be drawn with other families.

The legs are somewhat similar to those seen in many *Asellidæ*, being furnished with short dactyli, each armed with a strong curved claw, and a shorter spine below. A similar form of leg is, however, seen in *Sphæroma*. The epimera are united to the lateral margins of the thoracic segments almost precisely as in *Sphæroma*, an arrangement that does not prevail in the *Asellidæ*.

The pleon has all its six segments well developed and perfectly separated from each other, while in the *Asellidæ* they are united into a single scutiform segment, or at most, the basal segment only is more or less distinct. The pleopods are of the normal number and similar in form and texture throughout; the anterior pairs are ciliated. Each pair of pleopods consists of a basal segment, bearing an inner narrow lamella and an outer oval one, which, except in the fifth pair, are well ciliated. In the male the inner lamella of the second pair bears, on its inner margin, a stylet, as in *Sphæroma* and many other genera of Isopoda. In the *Asellidæ* the branchial pleopods are in fewer than five pairs, and are protected in front by a simple or compound operculum of firmer texture than the other pleopods. Dr. Coldstream* fell into an error in describing the respiratory organs as consisting of "six pairs of scale-like bodies, pendant from the anterior segments of the tail, * * arranged in three rows, in an imbricated manner, one of each kind ('oval' and 'nearly quadrangular') being articulated together on a common peduncle on either side." He further describes, loc. cit., p. 324, "two vesicular bodies of an oval form" behind the branchiæ. These organs were without doubt the external lamellæ of the fifth pair of pleopods, as shown by his figure. There are, however, four instead of three ciliated pairs anterior to the last pair, one of which was overlooked by Dr. Coldstream, and in this error he has been followed by Bate and Westwood.† If the observations of Dr. Coldstream had been correct, an affinity might have been indicated with the *Asellidæ*. The terminal segment is flattened and scutiform, in shape resembling that of *Jæra*, but the uropods are strictly lateral, being attached at the broadest part of the segment and in front of the middle.

* Edinburgh New Phil. Journal, vol. xvi, p. 323.

† Brit. Sessile-Eyed Crustacea, vol. ii, p. 350.

The relations of the present family with the *Sphæromidæ* appear to be more close, but the structure of the mandibles and perhaps also that of the maxillipeds, the fully segmented pleon and the biramous uropods seem to be characters of family value, which, however, a fuller investigation of the boring *Sphæromidæ* might go far to break down.

Limnoria Leach.

Limnoria Leach, Edinburgh Encyc., vol. vii, p. "433" (Am. ed., p. 273), "1813-14."

Mandibles with a nearly even chisel-like cutting-edge at the tip and no molar process; maxillipeds elongate, with a well-developed external lamella and a five-jointed palpus; first thoracic segment large; uropods with the outer ramus very short and almost obsolete.

The above characters differ from those by which Leach separated this genus from *Cymothoa* and the *Sphæromidæ*, with which he associated it.

Limnoria lignorum White (Rathke).

"*Cymothoa lignorum* Rathke, Skrivt. af Naturh. Selsk., v. 101, t. 3, f. 14, 1799" (White).

Limnoria terebrans Leach, Ed. Encyc., vol. vii, p. '433' (Am. ed., p. 273), "1813-14"; Trans. Linn. Soc., vol. xi, p. 371, 1815; Dict. Sci. nat., tome xii, p. 353, 1818.

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Dekay, Zool. New York, Crust., p. 48, pl. ix, fig. 33, 1844.

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White, List Crust. Brit. Mus., p. 96, 1847; Brit. Crust. B. Mus., p. 68, 1850.

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Andrews, Q. Jour. Mic. Sci., II, vol. xv, p. 332, 1875.

Limnoria lignorum White, Pop. Hist. Brit. Crust., p. 227, pl. 12, fig. 5, 1857.

Bate, Rep. Brit. Assoc., 1860, p. 225, 1861.

Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 351, figure, 1868.

Limnoria lignorum—Continued.

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Harger, This Report, part i, p. 571 (277), pl. vi, fig. 25, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

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Limnoria uncinata Heller, Verh. k. k. Zool. bot. Ges. Wien, B. xvi, p. 734, 1866.

Stalio, Cat. Crost. Adriatic, p. 211, 1877.

PLATE IX, FIGS. 55-57.

This species may in general be recognized by its habits, being usually found burrowing in submerged timber, to which, notwithstanding its insignificant appearance, it often proves very destructive.

The body is subcylindrical, tapering slightly at each end and covered above with short hairs to which more or less dirt usually adheres. The head is narrower than the first thoracic segment. The eyes are lateral and consist of about eight ocelli, one central and the others around it. The antennulæ (pl. IX, fig. 56 *a*) are short and seem to arise from near the middle of the front of the head. The basal segment is the largest; the second and third are of slightly decreasing size; the fourth or flagellar segment is much the smallest, and tipped with setæ. The antennæ (pl. IX, fig. 56 *b*) are more slender than the antennulæ, and arise just below their bases and a little farther apart. The first two segments are short; the third slightly longer; the fourth and fifth increasing somewhat in length; the flagellum is not longer than the last two peduncular segments, and consists of a tapering segment, followed by a few short terminal segments provided with a terminal brush of setæ. The maxillipeds (pl. IX, fig. 56 *c*) are slender; the external lamella is semi-ovate, with the inner margin nearly straight, acute, and ciliated at the tip; the palpus is five-jointed but short, with the segments flattened, and all but the first ciliated along their inner margins. The outer maxillæ (pl. IX, fig. 56 *d*) are slender, three-lobed, and ciliated at the tip. The inner maxillæ (pl. IX, fig. 56 *e*) are also slender, the inner lobe tipped with pectinate bristles, the outer with robust spines. The mandibles (pl. IX, fig. 56 *f*) are somewhat elongate, but of a simple form, being curved inward, flattened and chisel-shaped at the tip; below there is a slight tubercle, apparently the rudiment of the molar process; externally, above the origin of the palpus, is a prominent tubercle; the palpus is short, of three subequal segments, the last furnished with a rather imperfect comb of setæ.

The first thoracic segment is about twice as long as any that follow; it is crossed by a broad, shallow depression, and is rounded at the sides.

The second and third segments are each about half the length of the first. The epimeral sutures are evident, and the epimera are rounded behind in the second segment, but a little more prominent in the third, becoming acute and increasing in size and extension backward to the seventh. The fourth segment is slightly shorter than the third, and perhaps a little broader; the last three are short, decreasing in length to the seventh, but maintaining about equal width. The legs are short and rather robust. The first pair have the carpus triangular, but this segment becomes more elongate in the succeeding pairs. The dactyli are robust, and are armed with a strong curved spine or claw at the tip and a smaller one below it. The merus, and usually the ischium and carpus, bear a few spiniform tubercles on the lower surface except in the last pair, which are also more elongated and slender than the others.

The pleon is scarcely narrower than the thorax, and tapers but little; the first four segments are of equal length; the fifth is longer with a median elevation and a transverse depression on each side. The last segment (pl. IX, fig. 57*a*) is transversely oval or subcircular, broader than long, with the anterior margin raised, especially at the middle, where the elevation is continued a short distance on the segment, but posteriorly it is flattened. The posterior margin is ciliate with hairs of various lengths. The uropods (pl. IX, fig. 57*b*) are attached just in front of the middle of the segment at its widest part. They consist on each side of a somewhat wedge-shaped basal segment, ciliated and bluntly denticulated distally on the outer side, and supporting two rami, between which it is produced below into a strong tooth-like process. The outer ramus is very short and curved outward; the inner is not as long as the basal segment, and is ciliated externally and at the tip. Underneath, the pleon is much excavated for the pleopods, which are strongly ciliated. The first pair (pl. IX, fig. 57*c*) consist on each side of a short basal segment bearing two lamellæ; the inner lamella is almost four times as long as broad, with nearly parallel sides, ciliated at and near the tip; the outer, which is also in front of the inner, is sub-oval with the outer margin more convex than the inner, ciliated near the tip and along most of the outer margin, and inserted a little obliquely upon the basal segment. The next three pairs of pleopods are similar to the first pair on each side, except that in the males the second pair (pl. IX, fig. 57*d*) bears a stylet (*s*) articulated to the inner margin of the inner lamella about the middle. The posterior pair of pleopods are smaller than the others and not ciliated.

Length 4.5^{mm}; breadth 1.5^{mm}; color light grayish.

Much has been written upon the destructive habits of the *Limnoria* or "gribble" and the means of preventing its attacks on woodwork, for which the reader may consult especially the publications of Leach, Coldstream, Hope, Thompson, Moore, Gould, Bate and Westwood, Verrill, and Andrews, who has observed it attacking the gutta-percha of submarine telegraph cables.

It is found boring in submerged wood along our coast from Florida! to Halifax!, N. S., and the Gulf of St. Lawrence. It occurs above low-water mark, but does not usually live far below that line; it has, however, been found by Professor Verrill at a depth of 10 fathoms in Casco Bay, and was dredged by the U. S. Fish Commission in a depth of $7\frac{1}{2}$ fathoms, Cape Cod Bay!, Mass., in the summer of 1879. It is abundant, according to European authors, in many localities on the coast of Great Britain and in the North Sea. *L. uncinata* Heller, from Verbosca, in the Island of Lesina, Adriatic Sea, appears to be the same species, as the differences pointed out by Heller do not really exist, but were doubtless suggested by the incorrect figures that have been published representing the uropods with rami composed of two or more segments. The form of these appendages, as shown on plate IX, fig. 57 *b*, corresponds well with Heller's description. It was found by Heller associated with *Chelura terebrans*. *Limnoria* is said also to occur in the Pacific Ocean, and from its habits might be expected to have a wide distribution.

Specimens examined.

Number.	Locality.	Habitat.	When collected.	Received from—	Number of Specimens.	Dry. Alc.
2048	Florida	Boring in wood		Smithsonian Inst.	6	Alc.
	Provincetown, Mass.	do	Aug., 1879	U. S. Fish Com.	00	Alc.
2047	Casco Bay	do	—, 1873	do	30	Alc.
	Bay of Fundy	do	—, 1872	do	00	Alc.
	Halifax, N. S.	do	—, 1877	do	00	Alc.

IX.—CIROLANIDÆ.

Front formed of the approximate basal segments of the antennulæ, which are not covered by an anterior projection of the head; antennulæ and antennæ presenting an evident distinction into peduncular and flagellar segments; maxillipeds with a five-jointed palpus; mandibles formed for biting, palpigerous; legs all terminated by nearly straight dactyli; epimera distinct behind the first thoracic segment; pleopods at least the anterior pairs, ciliated; uropods biramous, the rami flattened and ciliated.

This family is represented on our coast by two closely allied species apparently belonging to the typical genus *Cirolana*, although approaching the allied genus *Conilera*, to which I formerly referred them. They have been hitherto usually referred to the following family, but the differences in the structure of the mouth parts, first pointed out by Schiödde, seem to warrant their separation as a distinct family. The mandibles are formed for biting, being armed with long and powerful teeth, which, closing together like the blades of scissors, are well adapted for lacerating the flesh of fishes on which they feed. The first three pairs of legs are fitted for prehension, but they are destitute of the strongly curved

dactyli found in the *Ægidæ*, and still better developed in the *Cymothoidæ*. In the *Cirolanidæ* the propodus, in the first three pairs of legs, is somewhat curved and the dactyli are nearly straight, so that while the first three pairs of legs are powerful organs of prehension, they are also capable of letting go preparatory to the seizure of another victim. The posterior pairs of legs are ambulatory or fitted for swimming by their form and armature of bristly hairs. The ciliated pleopods are also powerful swimming organs, so that these animals are well fitted for the predatory life they lead. The epimera are well separated by sutures in all the thoracic segments behind the first. The pleon is scarcely narrower at base than the last thoracic segment, and is composed of six distinct segments, of which the last is much the longest, but not broader than the preceding segments, and tapers posteriorly. The uropods are lateral, articulated near the base of the last segment and distinctly biramous.

The mouth-organs of this and the two following families have been the object of special research by J. C. Schiödte, whose papers in the *Naturhistorisk Tidsskrift* have been in part translated in the *Annals and Magazine of Natural History*. He regards *Cirolana* as representing "the highest development of the crustacean type among the Isopoda," and even hints that *Cirolana* and *Æga* should be removed to opposite ends of the series of Isopoda. The same author would closely unite the *Bopyridæ*, *Æga*, and the *Cymothoidæ* into a single group, the *Cymothoæ*, while acknowledging that the young of *Cymothoa cæstrum*, "according to the classification hitherto current, * * * would rather be allied to *Cirolana* than to *Cymothoa*." His classification, however, appears to be based almost entirely upon the structure of the mouth, disregarding the totality of structure upon which alone morphological classification can securely rest. In deference, however, to his views I have here regarded *Cirolana* as the type of a distinct family, which must still be considered as closely related with the two following families, on the principle that it is "more important that similarities should not be neglected than that differences should be overlooked."

Among the more important of the similarities by which these families seem to be united may be mentioned the following, as exemplified by our species. The segments of the thorax and pleon are all distinct from each other, so that the body, in the adults, appears to consist of thirteen segments behind the head, although in the genus *Ourozeuktes* Edwards* the segments of the pleon are consolidated. The epimera are distinct in all the segments behind the first thoracic. The pleon may or may not taper from the base, but it is terminated by a large scutiform segment, sometimes more or less sculptured, and bearing at the sides, near the base, a pair of uropods, in which the basal segment is more or less oblique distally and the rami lamelliform, though one of them may be narrowly so. The pleopods are unprotected by any form

* Hist. nat. des Crust., tome iii, p. 275, 1840.

of operculum and the anterior pairs are ciliated in the young of all three families, but this ciliation, as well as that on the uropods, may be lost in the sedentary adults of the *Cymothoidæ*. In all our species the dorsal surface is smooth throughout, or minutely punctate under a lens, but destitute of distinct roughness, tuberculation or sculpture, except that the telson may be faintly grooved or sculptured, and in some foreign species more distinctly so.

Cirolana Leach.

Cirolana Leach, Dict. des Sci. nat., tome xii, p. 347, 1818.

Thoracic segments subequal; eyes small, well separated; mandibles armed with strong acute teeth; dactyli straight, or but slightly curved; pleon of six distinct segments; basal segment of uropods with the inner angle produced.

Two closely allied species are found on this coast, which I formerly referred to the genus *Conilera* Leach. Further consideration induces me to refer them rather to the present genus, although they have some features which point toward *Conilera*, and are perhaps between that genus and the typical forms of *Cirolana*. From *Conilera*, as described by Bate and Westwood, our species differ principally in the more robust four posterior pairs of legs, in the produced angle of the basal segment of the uropods, and in the structure of the first pair of pleopods, which are not operculiform either in size or texture. Of these two species one is abundant and is described at length. The description will, however, apply almost equally well to the other except in the few points mentioned in the appropriate place. The characters given, though slight, appear to be constant, and I have therefore retained the two specific names.

This genus differs from *Æga* in the structure of the legs, and was placed by Professor Dana in a separate subfamily. In *Cirolana* the first three pairs of legs are strong, and armed with minute spine-like claws at the tip of the nearly straight dactyli; the propodi in these legs are robust, spiny, and somewhat curved, and some of the preceding segments are also armed with spines. These legs thus form powerful organs for seizing living prey, and are not, as in the *Cymothoidæ*, and, in a less degree, in *Æga*, merely fitted by their curved dactyli to retain the hold of the animal upon its host in a parasitic existence. The last four pairs of legs are well ciliated and capable of use either for walking or swimming, and these animals are thus fitted for their active and predaceous life.

Cirolana concharum Harger (Stimpson).

Æga concharum Stimpson, Mar. Inv. G. Manan, p. 42, 1853.

Lütken, Vidensk. Meddel., 1859, p. 77, 1860.

Conilera concharum Harger, This Report, part i, p. 572 (278), 1874.

Verrill, This Report, part i, p. 459 (165), 1874.

Cirolana concharum Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

PLATES IX AND X, FIGS. 58-63.

This species may be most readily recognized among our Isópoda by the distinct thoracic and abdominal segments, the small lateral eyes, and the evident distinction, in both antennulæ and antennæ, of peduncle and flagellum. From the next species it is distinguished by the tip of the telson, which is truncated, or slightly emarginate, and grooved on the median line above near the end.

The body is, when extended, about three times as long as broad, and is smooth and polished throughout. The head is quadrate, a little broader in front than behind, and embraced at the sides by the first thoracic segment. The eyes are triangular, with the angles rounded, and are often partially covered below by the projecting anterior lobes of the first thoracic segment. They are separated by about three times their longest diameter. The antennulæ (pl. X, fig. 60) are robust, with their basal segments in contact; the first segment is short and sub-spherical; the second also short; the third cylindrical and as long as the first two taken together and followed by a robust, but short, tapering flagellum, consisting of about fifteen segments, of which the second is as long as any other two, but the rest are all short. The flagellar segments beyond the first are provided each with a tuft of "olfactory setæ." The antennæ (pl. X, fig. 61 *a*) are longer and more slender than the antennulæ, and are separated at their bases. The first four peduncular segments are robust; the first two short; the third and fourth each about twice as long as the first or second, and the fifth or last peduncular segment slightly the longest and much the most slender. The fourth and fifth segments bear along the distal portion of their outer margins long bristle-form hairs. The flagellum is slender and composed of from 15 to 18 segments, each bearing a few short bristles. The maxillipeds (pl. X, fig. 62 *a*) are elongated and almost pediform but flattened; the external lamella is small and subtriangular, rounded and hairy at the tip; the palpus is five-jointed, with the last four segments broad, flattened, and well ciliated; the tip of the maxilliped, nearly concealed by the large palpus, is provided with very densely plumose bristles. The outer maxillæ (pl. X, fig. 61 *b*) are short and robust; the two articulated lobes narrow ovate, rounded at the tip, armed, especially the inner one, with spines and plumose or pectinated bristles. The inner maxillæ (pl. X, fig. 61 *c*) are robust, with the outer lobe armed with strong smooth spines; the inner lobe rounded at the end and bearing three straight rather blunt spines, densely covered toward the tip with soft hairs. The mandibles (pl. X, figs. 61 *d*) are robust and horny at the tip, armed with one strong acute tooth, and in the right mandible with one acute and one obtuse tooth along a cutting edge, while the left mandible has three less acute teeth along this edge. Each mandible is, moreover, provided with a molar process or area (*m*), on its inner surface set along its interior and upper margin with spines. A narrowly lanceolate leaf-like appendage is attached just below the molar area. This appendage

is furnished with a few bristles near the base, and its upper edge is armed with minute denticles; it is movable and ordinarily concealed behind the mandible. On the external surface, just above the origin of the palpus, each mandible bears two elevated, conical, obtuse tubercles. The palpi are slender, the second segment longest and hairy on the margin beyond the middle, the last segment slender and curved, with the usual hairs or slender bristles along the inner curvature.

The second and third thoracic segments are a little shorter than the others, which are of about equal length. The fourth and fifth segments are widest. The first segment is produced at the sides around the head so as to very nearly attain the anterior lateral angles of the head, and often so as to obscure the lower margin of the eyes. The epimeral sutures are scarcely distinguishable in this segment, but evident in the following segments. The epimera are rounded behind as far as the fourth, but the fifth is slightly angulated, and the sixth and seventh acute and produced backward beyond the margin of the corresponding segment. The first pair of legs are short and stout, and well armed with spines and bristles; the basis is of the ordinary form; the ischium is nearly triangular, having the upper margin much produced in the distal portion and bristly; the merus is expanded in a somewhat similar manner, but the angle is bent forward beyond the short carpus over the base of the propodus; the opposite or lower margin of the merus is armed with short stout spines; the carpus is short and small and possesses but little motion on the propodus, which is robust, somewhat curved, and bears a strong short dactylus. The second and third pairs of legs resemble the first pair, but the carpus increases somewhat in size, and there is more motion in its articulation with the propodus. They are directed forward, while the remaining pairs are usually directed backward and are more flattened. The fourth pair of legs are short like the first three (pl. X, fig. 62 *b*), but, except in size, resemble the following pairs. They are well provided with bristles in tufts, and along the margins of the segments, and especially the merus and two adjacent segments, are armed with long stout spines. The propodus is straight and much more slender than the carpus. The fifth and sixth pairs of legs increase in size, and the propodus especially becomes more elongated, but the seventh pair are a little smaller than the sixth.

The pleon is scarcely narrower at base than the last thoracic segment, and the first segment is often nearly concealed by the last thoracic. The fifth segment is longer on the back but shorter at the sides than the preceding segments. The last segment, or telson, is triangular with the ciliated apex truncated and emarginate or notched at the end of a short median furrow at the tip. The uropods (pl. X, fig. 63) slightly surpass the telson and are strongly ciliated; the inner ramus bears also a few spines near the tip; the basal segment has the inner angle produced along the margin of the inner ramus, which is broad and expanded

distally, with a notch at the external angle; the outer ramus is slender and tapering, slightly surpassing the inner.

Length of large specimens 32^{mm}, breadth 10^{mm}, but usually smaller; 22^{mm} long, 7^{mm} broad. The ground color in life is yellowish, with reddish brown on the anterior margin of the head and on the posterior margins of the segments, especially in the dorsal region, where the segments are also marked with black dots. In life the body is somewhat translucent in the thinner parts. In alcohol the translucence disappears and the color fades to a nearly uniform yellowish or buff with black dots.

This species was described by Stimpson from Charleston, S. C. Most of the specimens in the collection are from Vineyard Sound!, where it occurs sometimes in great abundance, and is common especially during the winter. It is found swimming about in shallow water, and may be taken in a scoop-net, and is found also in lobster-pots. It was dredged in 45 fathoms off Block Island!, near the eastern end of Long Island Sound, in 1874, but has not yet been found north of Cape Cod.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry-Alc.
2061	Off Fishers Island.....		.....	May —, 1875	J. H. Latham..	100+	Alc.
2060	Vineyard Sound.....		.....	Mar. —, 1874	V. N. Edwards..	10	Alc.
2065	do.....	S. f.	.....	Aug. 25, 1875	U. S. Fish Com.	1	Alc.
2062	Eel-pond, Wood's Holl.....		Muddy.....	July 23, 1875	do.....	100+	Alc.
2063	Off New Shoreham.....		.....	Aug. 19, 1874	do.....	1	Alc.
2064	Off Martha's Vineyard.....	18	Sandy.....	Sept. 20, 1875	do.....	1	Alc.

***Cirolana polita* Harger (Stimpson.)**

Aga polita Stimpson, Mar. Inv. Grand Manan, p. 41, 1853.

Lütken, Vidensk. Meddel., 1859, p. 77, 1860.

Verrill, Am. Jour. Sci., III, vol. v, p. 16, 1873.

Conilera polita Harger in Smith and Harger, Trans. Conn. Acad., vol. iii, pp. 3, 22, 1874.

Verrill, Am. Jour. Sci., III, vol. vii, p. 411, 1874.

Cirolana polita Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

This species so closely resembles the preceding, that a full description would be little else than a repetition of that given above. It appears, however, to differ constantly from the form already described, by its somewhat more elongated and cylindrical body; in the eyes, which are "elongate trapezoidal in shape, narrowest anteriorly," and in the tip of the telson, which is regularly rounded or slightly pointed at the tip without any truncation, much less any emargination, and is not at all grooved above.

Length 25^{mm}, breadth 6.5^{mm}; color much as in the preceding species.

Dr. Stimpson's specimens were "found on the fine sands at low-water mark on High Duck Island," in the Bay of Fundy, and the specimens that I have examined are from Cape Cod Bay!; from near Salem!, Mass.;

George's Banks!, and east of Banquereau!, or Quereau, latitude $40^{\circ} 36'$ north, longitude $57^{\circ} 12'$ west, where seven fine specimens were taken from a halibut (*Hippoglossus*), June 2, 1879, by Capt. J. W. Collins. It appears to replace the preceding species at the north.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
	Cape Cod Bay	7	Coarse, yellow sand.	Sept. 15, 1879	U. S. Fish Com.	2	Alc.
1314	George's Bank, lat. $41^{\circ} 40'$ N., lon. $68^{\circ} 10'$ W.	25	Sand.....	— —, 1872	Smith and Harger.	1	Alc.
1399	George's Bank, lat. $42^{\circ} 11'$ N., lon. $67^{\circ} 71'$ W.	150	Soft, sandy mud.	— —, 1872	Packard and Cooke.	1	Alc.
	Salem, Mass. ....	.....	.....	— —, 1878	J. H. Emerton.	1	Alc.
	East Quereau	190	.....	June 2, 1879	Capt. J. W. Collins.	7	Alc.

X.—ÆGIDÆ.

Front formed of the approximate basal segments of the antennulæ, which are not covered by an anterior projection of the head; antennulæ and antennæ presenting an evident distinction into peduncular and flagellar segments; maxillipeds operculiform; mandibles formed for piercing, palpigerous, mouth suctorial; first three pairs of legs ancoral, last four ambulatory; epimera distinct behind the first thoracic segment; uropods lateral, biramous, ciliated, and flattened.

This family was represented within our limits by a single species of the typical genus until the summer of 1879, when a single specimen was collected of a second genus belonging to the *Ægidæ*, but having evident relations with the next family, and in many characters intermediate between *Æga* and the *Cymothoidæ*. The two genera by which the family is at present represented on our coast may be further characterized as follows: Both the antennulæ and the antennæ are directed laterally, the former arising near together on the anterior margin of the head and forming part of the outline of the animal as seen from above. They, as well as the antennæ, present an evident distinction into peduncular and flagellar segments. The maxillipeds are operculiform, and have the palpus armed with short hooks for adhesion to the surface of the fish on which they may be feeding. The mandibles are armed with a horny point, but not toothed as in the *Cirolanidæ*, and, while fitted for piercing, are not capable of lacerating and biting off pieces of flesh as in that family.

The first three pairs of legs are ancoral, or armed with strong curved dactyli, which, once implanted in the body of a victim, retain their hold without effort—a structure which attains its fullest development in the

following family. The remaining pairs of legs are fitted for walking. The thoracic segments are subequal in length and have the epimera well separated, except in the first segment.

The pleon may or may not be suddenly narrower than the last thoracic segment, and, in our species, is composed of six distinct segments, of which the last is large and scutiform. The uropods are composed of a basal segment, oblique at the apex with the inner angle more or less produced, and bearing two flattened, ciliated rami; they are distinctly lateral, being inserted high up on the sides of the last segment.

This family contains our largest Isopod, *Æga psora*, and to it should probably be referred the huge *Bathynomus giganteus* A. Edwards, from the Gulf of Mexico, measuring more than eleven inches in length. It has usually been regarded as embracing the *Cirolanidæ*. I have already given my reasons for separating them, but have to regret my inability to examine many types of genera apparently more or less intermediate in position between *Æga* and, on the one hand *Cirolana*, and on the other *Cymothoa* and *Livoneca*. I have therefore retained the old classification rather than to unite the following genera with the *Cymothoidæ*.

Our two genera are most easily distinguished as follows: Eyes large and approximate, *Æga*, p. 89; eyes wanting, *Syscenus*, p. 93.

Æga Leach.

Æga Leach, Trans. Linn. Soc., vol. xi, p. 369, 1815.

Eyes large; palpus of maxillipeds five-jointed; three anterior pairs of legs terminated by strong curved claws; posterior pairs slender, with slender nearly straight dactyli; pleon not suddenly narrower than the thorax; pleopods ciliated.

This genus is represented within our limits by a single species, which may be easily distinguished by its large approximate eyes. The basal segments of the antennulæ are flattened and the flagellum is comparatively slender. The maxillipeds have a five-jointed palpus, which is short and flattened and bent around the oral opening, and the inner margins of the three terminal segments are provided with a row of strong hooked spines, which are also found upon the outer maxillæ, thus forming two rows of short hooks on each side of the mouth, by means of which the opening of the mouth can be closely applied to the fish on which these animals prey. The inner maxillæ are slender and styliform and armed with sharp curved spines at the apex, and the mandibles are also acute and fitted for piercing. The body is moderately convex, and the last four pairs of legs are nearly alike ambulatory and of moderate length, the last pair, when extended, scarcely surpassing the telson. The pleon is composed of six distinct segments, and the basal segment of the uropods is strongly produced at its inner angle, as usual in the family. The pleopods are ciliated in the adults as well as in the young.

Æga psora Krøyer (Linné).

Oniscus psora "Linné, Fauna suecica, ed. ii, 1761"; Syst. Nat., ed. xii, tom. i, p. 1060, 1767.

"Pennant, Brit. Zool., vol. iv, pl. 18, fig. 1, 1777 (certe)" (B. & W.).

O. Fabricius, Fauna Grœnlandica, p. 249, 1780.

Mohr, Islandisk Naturhistorie, p. 110, 1786.

Æga emarginata Leach, Trans. Linn. Soc., vol. xi, p. 370, 1815; Dict. Sci. nat., tome xii, p. 349, 1818.

Samouelle, Ent. Comp., p. 109, 1819.

Desmarest, Consid. Crust., p. 305, pl. 47, figs. 4, 5, 1825.

Griffith and Pidgeon, Nat. Hist. Crust., p. 218, pl. viii., fig. 3, 1833.

Edwards, Hist. nat. des Crust., tome iii, p. 240, 1840; Règne Anim., Crust., pl. iv, fig. 4, and pl. lxxvii, fig. 1, 1849.

Gould, ?Rep. Geol. Mass., p. 549, 1835; Invert. Mass., p. 338, 1841.

Gosse., Man. Mar. Zool., vol. i, p. 134, 1855.

Æga (*Oniscus psora*) Krøyer, Grønlands Amfipoder, p. 318, 1838.

Æga psora Lilljeborg, Öfvers, Vet.-Acad. Förh., 1850, p. 84, and 1851, p. 24.

Lütken, Vidensk. Meddel., 1858, pp. 65, 179, 1859; *ibid.*, 1860, p. 181 (7) 1861; Crustacea of Greenland, p. 150, 1875.

Schiödte, Ann. Mag. Nat. Hist., IV, vol. i, p. 12, 1868.

Bate & Westwood, Brit. Sess. Crust., vol. ii, p. 283, figure, 1868.

M. Sars, Chr. Vid. Selsk. Forh., 1868, p. 261, 1869.

G. O. Sars, Hard. Fauna, Crust., p. 275 [32], 1872.

Verrill, Am. Jour. Sci., III, vol. v, p. 16, 1873.

Smith and Harger, Trans. Conn. Acad., vol. iii, p. 22, 1874.

Whiteaves, Further Deep-Sea Dredging, Gulf St. Lawrence, p. 15, "1874."

Metzger, Nordseefahrt der Pomm., p. 235, 1875.

Meinert, Crust. Isop. Amph. Dec. Danicæ, p. 89, "1877."

Miers, Ann. Mag. Nat. Hist., IV, vol. xix, p. 134, 1877.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

Æga entaillée Latreille, Règne Anim., tome iv, p. 134, 1829.

PLATE X, FIG. 64.

The present species is the largest Isopod, and indeed the largest Tetradecapod known on the New England coast, reaching a length of nearly or quite two inches and a breadth of one inch, and has even attained to the dignity of a popular name, "salve-bug", by which it is known among fishermen. It may be further distinguished by its large approximate eyes, covering a large proportion of the upper surface of the head, and by the possession of ancoral legs in three pairs only, the last four pairs of legs being fitted for walking.

The body is oval, broadest at the fourth and fifth thoracic segments, where the breadth is about half the length. The dorsal surface is moderately convex and smooth except for minute and rather scattered punctations, which occur also on the legs, especially on the basal segments, on the antennulæ, the uropods, and even the pleopods. The head is transverse and sub-triangular, salient in front between the bases of the antennulæ. Much of the upper surface of the head is covered by the large oval or somewhat reniform eyes, which do not quite meet on the median line. The antennulæ when bent backward nearly or quite attain the anterior margin of the first thoracic segment, and

have their first two segments large and flattened, and wedge-shaped in front; of these the basal segment is quadrate in outline, as seen from above, and nearly as broad as long; it closely approaches its fellow of the opposite side in front, but is separated from it behind by a median process of the head; the second segment is triangular in outline, as seen from above, with the apex of the triangle extending beyond the origin of the third slender cylindrical segment, which is followed by a tapering flagellum of about a dozen segments. The antennæ when reflexed extend beyond the first thoracic segment and have the first two segments short and compressed, the third somewhat longer, the fourth and fifth longer and nearly cylindrical, followed by a tapering flagellum about as long as the peduncle and composed of fifteen to twenty segments. The maxillipeds have a short triangular external lamella and a five-jointed palpus, of which the first segment is short and transverse; the second is triangular and bears, on its inner apex, a few slender hooked spines; the third segment is broad and flattened, with the inner margin short, and armed with about three robust hooked spines; the fourth segment is flattened and transverse and armed along its inner margin with about six similar spines; while the fifth segment is small, sub-oval, and armed with much more slender curved spines. The outer maxillæ are provided with curved spines at the apex much like those of the maxillipeds. The inner maxillæ are rod-like and terminate in sharp somewhat curved spines placed close together. The mandibles support a slender palpus of three segments, of which the middle one is much the longest, and the last is robust and sickle-shaped, with a comb of short spines along the inner curve. This segment lies, in the ordinary position, just at the base of the antenna of the same side.

The first thoracic segment is, at its anterior margin, scarcely broader than the head, but expands rapidly backward. It is excavated in front for the eyes, which project somewhat beyond the posterior margin of the head. The second, third, and fourth thoracic segments are each a little shorter than the first; the fifth and sixth are somewhat longer; the seventh is shorter than the sixth. The epimera of the first thoracic segment are not separated by suture, but in the second and following segments they are so separated, and, especially on the anterior segments, marked with two oblique depressed lines. The epimera of the second, third, and fourth segments are rounded or truncate behind, but in the posterior segments they become acute and extend beyond the angles of the segments to which they are attached. The first three pairs of legs are short and armed with strong hooked dactyli. The propodal segments are also curved, and the carpus is short in the first pair but somewhat longer in the second and third pairs. The merus is almost crescent-shaped in the first pair of legs, its horns embracing the carpus above and below, but it becomes more elongated in the succeeding pairs; in all three pairs its inferior margin is armed with a few short, stout spines. The fourth and succeeding pairs of legs are of quite a different

type from the first three. The four segments following the first or basal one are straight, cylindrical, or slightly compressed, armed with short spines, especially below and at the distal end, subequal in length but decreasing in diameter to the propodus, which bears in each pair a short, slightly curved and comparatively weak dactylus. The seventh pair is only imperfectly developed in the young specimen figured, but never quite attains the size of the sixth pair, which is the largest.

The pleon is scarcely narrower than the last thoracic segment and tapers but little to the fifth segment. The last segment is triangular, with the sides but little dilated, and is pointed at the tip without grooves or carinations. The uropods scarcely surpass the telson; the basal segment has its inner angle long and spiniform, extending the whole length of the inner margin of the inner ramus and ciliated toward the tip; the rami are flattened, the outer elongate ovate, obtuse; the inner with the inner margin straight, the outer curved and emarginate near the tip. Both rami and the posterior part of the telson are ciliated.

Length 16–50^{mm}, breadth 7–25^{mm}; color in alcohol light brown, darker toward the head; eyes black.

Linné's description of *Oniscus psora* is too indefinite to be certainly recognizable, and in using his trivial name I have followed the authority of Lütken and others. Our specimens agree well with the description of *O. psora* by O. Fabricius, and are undoubtedly identical with that species, which he describes as infesting the cod. They appear to correspond also with Bate and Westwood's figure and descriptions, although those authors make no mention of Fabricius under *Æ. psora*. As Kröyer referred the species to its proper genus, I have adopted his name as authority for the combination.

The specimen figured was dredged in the summer of 1872, a little to the northeast of St. George's Bank!, in latitude 42° 11' north, longitude 67° 17' west, in 150 fathoms, soft sandy mud with a few pebbles, and is young, as shown by its size and imperfectly developed seventh pair of legs. Adults may surpass the size of the figure, but the specimen drawn was enlarged three diameters. Adult specimens were obtained from the Provincial Museum, Halifax, Nova Scotia, labeled as found on the cod, and were probably from the fishing banks of that region, or from the Banks of Newfoundland. During the summer of 1879 a considerable number of specimens were received by the Fish Commission through the Gloucester fisheries, of which only a few are included in the table of specimens examined. These specimens were parasitic on the cod (*Gadus morrhua*), and on the halibut (*Hippoglossus*). Specimens have also been obtained from the skate (*Raia*). Whiteaves records this species from a halibut, on the north shore of the Gulf of St. Lawrence. Fine specimens were obtained by Mr. N. P. Scudder from off Holsteinborg, Greenland, in Davis' Straits!, parasitic on the halibut, and collected in July and August, 1879. It extends to Iceland (Edw. *et al.*); the British Isles (B. and W.); the North Sea (Metzger); Finmark (Sars), and Spitzbergen (Miers).

Specimens examined.

Number.	Locality.	Fathoms.	Parasitic on—	When collected.	Received from—	Number of specimens.	Dry. Alc.
1398	George's Bank, lat. 42° 11' N., lon. 67° 17' W.	150	-----	—, 1872	Packard and Cooke	1	Alc.
2139	-----	-----	-----	-----	Colonial Mus., Halifax.	2	Alc.
	George's Bank.	-----	-----	—, 1878	Schooner Alice G. Wonson.	3	Alc.
	do	-----	Codfish	May 8, 1879	J. P. Shemelia	3	Alc.
	do	-----	do	May 15, 1879	Capt. J. Q. Getchell	9	Alc.
	N. E. George's Bank.	47	do	Nov. 29, 1878	J. P. Shemelia	3	Alc.
2154	Gulf of Maine.	-----	Skate (<i>Raja</i>) ..	—, 1878	U. S. Fish Com'n ..	20	Alc.
2156	Banquereau.	-----	Halibut	—, 1878	Schooner Marion ..	1	Alc.
2157	-----	40-50	Codfish	—, 1878	Schooner Rebecca Bartlett.	1	Alc.
2158	Grand Menan Bank.	100	-----	—, 1878	Schooner Peter D. Smith.	3	Alc.
2155	do	100	-----	—, 1878	U. S. Fish Com'n ..	1	Alc.
	Brown's Bank.	52	Codfish	Dec. 19, 1878	Mr. Isaac Butler ..	2	Alc.
	do	-----	do	Feb. 13, 1879	Capt. J. Q. Getchell	2	Alc.
	do	30	do	May 1, 1879	do	8	Alc.
	Lat. 43° 25' N., Lon. 60° W.	180	Halibut	Aug. 21, 1879	Capt. S. W. Smith and crew.	.....	Alc.
	Davis's Straits.	-----	do	—, 1879	Mr. N. P. Scudder .	10	Alc.

***Syscenus** gen. nov.**

Eyes wanting; palpus of maxillipeds two-jointed; sixth and seventh pairs of legs elongated; pleon suddenly narrower than the thorax; pleopods naked.

This genus is unfortunately represented in the collection by a single specimen. It differs from *Æga* by characters that point toward the *Cymothoidæ*, as in the reduction of the segments of the palpus of the maxillipeds, the sudden constriction at the base of the pleon, and the naked pleopods. The absence of eyes, although a conspicuous character can hardly be regarded as of great taxonomic value. It is separated from the *Cymothoidæ* by the form of the head, which is not produced over the bases of the antennulæ but merely projects slightly between them. The antennulæ moreover are composed of three peduncular segments and a flagellum; the basal segments are much smaller than in *Æga* and less flattened, but still form a part of the anterior outline when seen vertically. The last four pairs of legs differ from the first three, and are more or less elongated and fitted for crawling. The uropods are distinctly ciliated.

***Syscenus infelix* sp. nov.**

This species may be recognized among our Isopoda by the possession of the full number of segments, the ciliated uropods, naked pleopods, and the absence of eyes.

* Συζήτης, a messmate.

The body is more than twice as long as broad and only moderately convex. The head is small and as seen from above is transversely somewhat diamond-shaped with rounded angles. It presents in front a slight prolongation between the antennulæ, and on each side of the short median process its outline is excavated above the bases of the antennulæ. The posterior margin is curved, but near each end is a faint indication of a lobe, projecting backward like the ocular lobes in *Æga*, but the eyes are wanting. The antennulæ arise near together on each side of the front and are short, extending when reflexed but little beyond the lateral margins of the head and only slightly surpassing the fourth antennal segment. They are readily distinguishable into peduncular and flagellar segments, the first three segments being of comparatively large size and about equal length; the second segment much flattened below against the antennæ; third more slender than the first two and followed by a short, tapering six-jointed flagellum. The antennulæ are in their natural position reflexed, the second segment being articulated at an angle with the first. The antennæ are considerably longer than the antennulæ and, when reflexed, slightly surpass the posterior border of the third thoracic segment. They are inserted below and a little outside of the antennulæ. The first segment is short and flattened below; the second is also short, the two together being hardly longer than the basal antennular segment; the third segment is about as long as the first two together, and the fourth is a little longer than the third, but of slightly less diameter; the fifth is more than one-half longer than the fourth, but is more slender and is followed by a slender, tapering flagellum of about twenty-four segments. The last two peduncular segments bear a row of elongate bristly hairs along the margin which, when reflexed, is brought next the body, and the row is continued, though with shorter hairs, along the flagellum. The palpus of the maxillipeds is composed of two segments of which the first is nearly square and armed at the inner distal angle with a minute hook; the second is bluntly triangular and armed at the apex, which is directed inward, with three hooklets. The external lamella is small and subcircular. The outer maxillæ are armed with short hooks at the tip; the inner with minute denticles. The mandibles are flattened and denticulate at the tip and bear a three-jointed palpus of which the three segments decrease in size to the last.

The first thoracic segment is twice as long as the second; its anterior margin is adapted to the head; its posterior margin is nearly straight above and rounded at the sides until the epimeral region is reached, when a short, pointed projection juts backward, being the tip of the epimeron on each side, here united with the segment. The next three—second, third and fourth—thoracic segments are of about equal length, and each a little over half the length of the first segment; their posterior margins are nearly straight above and rounded at the sides; the third segment is broadest. The fifth and sixth segments are each a

little longer than the second; the seventh about as long as the second. The last segment, and in a less degree the sixth and fifth segments, have their posterior margins excavated along the back; all have their lateral angles rounded, although the angles of the seventh segment are but slightly so. The epimera are short and pointed; those belonging to the second and third segments are larger than the following ones, and are applied directly to the lateral margin of the segments; the posterior four pairs of epimera are shorter and smaller, and are separated from the lateral borders of the segment by a fold of the integument cutting off a portion of the anterior lateral angle and increasing in size to the last segment.

The first three pairs of legs are alike, distinctly ancoral and directed forward. In each the basis is much the longest segment; the ischium is strongly flexed upon it; the merus is expanded distally around the base of the carpus and bears a few bristles at the outer angle; the carpus is short, less than half as long as the propodus, and the dactylus is strong and curved. The fourth pair of legs, like those that follow, is directed backward; the basis is the longest segment and the ischium is strongly flexed upon it and of more than half its length; the merus, carpus and propodus are each about two-thirds as long as the ischium, and all four segments are armed distally with a whorl of spines around the articulation with the succeeding segment; the dactylus is slender, sharp and curved. The fifth pair of legs is longer than the fourth by a little more than the length of the dactylus, the elongation being in the segments from the ischium to the propodus inclusive. The sixth pair is the longest, being, when extended, as long as the thorax and pleon together. This elongation is confined also to the four segments above indicated, and of these the ischium is about as long as the basis; the merus falls a little short of the ischium in length; the carpus and propodus are of equal length, and are as long as the ischium; all these segments are slender and slightly curved, and are armed distally and along their inner side with short spinules. The dactylus is slender and curved. The seventh pair of legs resembles the sixth but is shorter by about half the length of the propodus. The fifth pair does not attain the middle of the carpus of the sixth.

The pleon is of less diameter than the last thoracic segment and about as long as the last five thoracic segments. Its transverse diameter increases slightly to the base of the last segment, where it is broadest; the fifth segment is a little longer than the preceding one, and the last segment is of a broad ovate form, acuminate and ciliated at the tip, truncated at the base and smooth above, except for a faint transverse impression on each side near the base, and a still more faint impressed median line toward the tip. The uropods attain the tip of the telson but do not surpass it; they have the basal segment oblique but not produced at the inner angle, and bearing two elongate-elliptical

rami, tapering at the base and ciliated, the inner about one-third longer than the outer. The pleopods are quite naked and destitute of cilia.

Length 23^{mm}; breadth, 9^{mm}; breadth of pleon 4^{mm}; length of head 3^{mm}; breadth 4.2^{mm}.

A single specimen of this species was dredged by the U. S. Fish Commission, about fifteen miles northeast of Cape Cod!, in 130 fathoms brown mud, September 10, 1879.

XI.—CYMOTHOIDÆ.

Head produced anteriorly over the bases of the antennulæ; maxillipeds few-jointed, operculiform; mandibles palpigerous; mouth suctorial; legs armed with strong curved dactyli; epimera distinct behind the first thoracic segment; telson large and flattened; pleopods not ciliated; uropods articulated near the antero-lateral angles of the last segment, and composed of a more or less flattened basal segment bearing two flattened rami; habit parasitic; body often unsymmetrical by distortion in the adults.

This family is represented within our limits by three genera and as many species. They are parasitic in habit, usually on fish, and fix themselves by their strongly-curved claws to their host, often within the mouth, or about the branchial cavity, and frequently become distorted when fully grown. In all our species the head is small, and has the anterior margin produced, concealing the bases of the antennulæ and the antennæ. The head is three-lobed behind, and the first thoracic segment is adapted to it. The antennulæ and antennæ are both short and tapering, without very evident distinction into peduncular and flagellar segments. This distinction is, however, usually more or less evident on examination.

The epimera are well separated, except in the first segment, and may be projecting and conspicuous. The legs are of nearly the same form throughout, but increase in length and become more slender posteriorly.* The basal segments are in some genera enlarged and flattened, but not in ours; the joint between the basis and ischium is strongly flexed, and the segments, at least beyond the ischium, to the dactylus, are short and capable of but little motion on each other. The dactylus is strongly curved and admirably fitted for firm attachment to the host on which the animal may be living. In our species the legs, in the natural position, are concealed in a dorsal view beneath the body of the animal, to the under surface of which they are appressed, the first three pairs being directed forward, and the last three backward, as represented in plate X, fig. 66.

The pleon in our species is not suddenly narrower than the thorax, as it is, however, at least in the adults, in some genera belonging to this family. The segments of the pleon are distinct, the last one scutiform

* In *Artystone* Schiödte the seventh pair of legs "reach to the extremity of the tail and are slender, compressed crawling legs, with a small, almost rudimentary, straight claw."

and of moderate size, not being greatly enlarged. The pleopods are destitute of cilia in the adults.

This family is evidently closely related to the preceding and may yet have to be united with it, or even be extended so as to include also the *Cirolanidæ*. Our representatives of the three families are so few that I have had little opportunity to study the genera, and as before stated, I have separated the *Cirolanidæ* principally in deference to the opinions of Schiödte. *Alitropus* Edwards, *Syscenus* Harger, and *Ægathoa* Dana may be mentioned as genera pointing toward a transition between the *Ægidæ* and *Cymothoidæ*, and it is evident that the latter family is made up of forms degraded by parasitism. They have thus exchanged the ambulatory legs of the *Ægidæ* for strictly ancoral legs, for the most part in seven pairs, and have lost the natatory cilia of the pleopods. Their antennary organs are also much less perfect than in that family. All these modifications are in the line of the sedentary life of a parasite.

The interesting observations of Mr. J. F. Bullar have shown that in certain genera of the *Cymothoidæ* (*Cymothoa*, *Nerocila*, *Anilocra*) a peculiar form of hermaphroditism occurs, the young at a certain stage of development being males with well developed testes and external organs, but possessing at the same time ovaries with the oviduct ending blindly. As development proceeds the male organs are lost by molting, the oviduct obtains an external opening, the incubatory pouch is developed, and the animal becomes a female. Mr. Bullar's statements provoked considerable discussion, but they have recently been verified by Mayer, who has, however, shown that self-fertilization does not occur.

Three genera of *Cymothoidæ* are represented within our limits by as many species, and a fourth species, *Cymothoa prægustator* Say* (Latreille) may yet be found, being not a rare parasite in the mouth of the menhaden (*Brevoortia menhaden* Gill) in southern waters. The projection of the front of the head over the bases of the antennary organs, and the strongly hooked or ancoral legs are characteristic of the family, and the genera may be distinguished by means of the following table:

Uropods	{	ciliated, eyes large conspicuous,	<i>Ægathoa</i> , p. 393
		naked; body { symmetrical; posterior epimera elongated,	<i>Nerocila</i> , p. 391
		unsymmetrical; epimera short,	<i>Livoneca</i> , p. 394

Nerocila Leach.

Nerocila Leach, Dict. Sci. nat., tom. xii, p. 351, 1818.

Body oval; head small; eyes of moderate size; posterior thoracic segments and epimera angulated or spiniform, giving a sharply serrated or dentated outline to the thorax; first two "abdominal epimera" also spiniform; pleon of six distinct segments.

Our species of *Nerocila* has the characters of the genus much less pronounced than some foreign ones, as the posterior epimera are nearly

* Jour. Acad. Nat. Sci. Phila., vol. i, p. 395, 1818.

or quite concealed from above by the projecting angles of the segments, and the "abdominal epimera" are mostly concealed beneath the pleon. These organs are the much elongated inferior angles of the segments, which in allied genera, as *Egathoa*, are short and not produced. In a lateral view they considerably resemble the posterior epimera, giving the appearance of two additional pairs. The specimen first described is smaller than others that have since been obtained.

***Nerocila munda* Harger.**

Nerocila munda Harger, This Report, part 1, p. 571 (277), 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

Verrill, This Report, part i, p. 459 (165), 1874.

PLATE X, FIG. 65.

This species may be recognized among our Isopoda by the projecting posterior epimera, and the two pairs of spiniform "abdominal epimera" beneath the pleon.

The body is oval, twice as long as broad, smooth, polished, and moderately convex. The head is flattened, broader than long, narrowing anteriorly, broadly rounded or subtruncate in front, three-lobed behind, with the middle lobe largest. The eyes are black and consist of an irregularly rounded patch of small indistinct ocelli, and are visible both above and below. The antennulæ are about as long as the head, and composed of eight segments, of which the first is short, the second is the longest, and the remaining six decrease pretty regularly in size to the last. The antennæ are a little longer and more slender than the antennulæ and have the first segment short, the second subglobose, the third, fourth, and fifth cylindrical, and a little larger than the segments of the flagellum, which are about five in number. The mandibular palpi are longer than any three segments of the antennæ, and the first segment is large, the second elongate conical, the third shorter, cylindrical.

The first thoracic segment is much longer than the succeeding ones and adapted to the head in front. It is slightly produced at its lateral angles behind, or rather appears so from the union of the epimera, which really constitute the projecting angles to the segment. In the second, third, and fourth segments the posterior angles are but little produced, and are equaled or slightly surpassed by the epimera, but in the last three segments the posterior angles are acutely produced much beyond the epimera of the corresponding segments, the angle of the sixth segment nearly attaining the end of the seventh epimeron. In a lateral view, only the last two epimera are decidedly acute, while those of the second and third segments are obtuse and rounded behind. Seen from below, the posterior angles of the epimera are acute throughout. The first pair of legs are slightly more robust than the second and third; the last four pairs are still more slender, the last pair longest, and the last two pairs armed with a few short spinules.

The pleon is shorter than the thorax and much narrower, though

not suddenly so and tapers but little posteriorly; the telson is flattened, and regularly rounded behind. The "abdominal epimera" are acute, the second smaller and more slender than the first, but their extension backward varies with the state of contraction of the pleon. The uropods (pl. X, fig. 65 *a*) surpass the telson, and have the inner angle of the basal segment sharply produced. The rami are flattened; the external one twice the length of the basal segment, narrowly ovate or lanceolate, sometimes slightly curved, and surpassing the telson by half its length. The inner ramus is narrowly oval, obliquely truncate behind and about three-fourths as long as the outer.

The length of the specimen figured, which was the one first described, is 15^{mm}, breadth 7^{mm}, but specimens measuring 25^{mm} in length have since been collected; color brown or greenish, with two narrow dorsal bands of lighter color, most evident at the extremities.

The original specimen was obtained on the dorsal fin of *Ceratocanthus aurantiacus* at Wood's Holl!, Vineyard Sound, in 1871, and two more specimens of larger size have since been obtained, also from Vineyard Sound!, Mass.

Ægathoa Dana.

Ægathoa Dana, Am. Jour. Sci., II, vol. xiv, p. 304, 1852.

Body elongate oval; pleon not suddenly narrower than the thorax; head large, subtriangular; eyes large; legs nearly alike throughout, with strong curved dactyli; epimera of moderate size or small; pleon long and large, composed of six distinct segments; pleopods not ciliated; uropods more or less distinctly ciliated, rami subequal.

This genus is represented in our fauna by a species parasitic in the mouth of a squid. The large, granulated eyes remind one of *Æga*, and the ciliated uropods also indicate the approximation of this genus to the preceding family. The ciliation is, however, nearly rudimentary in our species, and is present, at least in the young, of other members of the *Cymothoidæ*.

Ægathoa loliginea Harger.

Ægathoa loliginea Harger, Am. Jour. Sci., III, vol. xv, p. 376, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 161, 1879.

PLATE X, FIG. 66.

The legs all armed with strong curved claws, the large conspicuous eyes and the slightly ciliated uropods serve to distinguish the present species from the other Isopoda of our coast.

Body elongate oval in outline, nearly four times as long as broad, slightly dilated near the posterior end. Head broadly rounded in front, subequally, but not deeply, trilobed behind. Eyes large, with evident facets, lateral, semi-hexagonal, visible from below, covering nearly half the area of the head above, projecting posteriorly beyond the middle

lobe of the head. Exteriorly they form about two-thirds of the lateral margin of the head. Their interior boundary is in the form of three sides of a hexagon, separated at their nearest points by a little more than the transverse diameter of the eye. The antennulæ are about as long as the head, composed of eight segments and separated at the base. The first segment is short and stout; the next two a little longer, but scarcely distinguishable from the following five flagellar segments, which decrease in size to the last. The antennæ are composed of ten segments. They are more slender than the antennulæ, and surpass them by about two segments. The first two segments are broader than the following three, which are also somewhat larger than the five flagellar segments.

The first thoracic segment is shorter than the head, but much longer than any of the succeeding segments, which to the sixth are of equal length, each about one-third shorter than the first. The seventh segment is about one-third shorter than the sixth. The fifth and sixth are broadest, each being about one-third broader than the first. The epimera do not project behind the angles of the segments to which they are attached. The legs differ but little throughout. The first pair are shortest, and the first three pairs are somewhat stronger than the last four, which are armed with a few scattered short spinules. The seventh pair are the longest.

The pleon is a little longer than the seven thoracic segments. The fifth segment is broader behind than in front, and the last segment is as broad at the insertion of the uropods as the third segment, and is rounded behind. Anterior pleopods with the basal segment nearly square. The uropods are unlike on the opposite sides in the specimen figured. The normal form is probably seen in the right uropod, which surpasses the telson by less than half the length of the outer ramus. This ramus is longer than the inner, narrow, with nearly parallel sides and is obliquely truncated at the tip. The inner ramus is somewhat diamond-shaped. The ciliation is nearly rudimentary and might be overlooked. The basal segment is alike on the two sides and has the inner distal angle acute and but slightly produced.

Length 13^{mm}, breadth 3.6^{mm}; color in alcohol yellowish, with minute black specks most abundant on the pleon; eyes black, conspicuous.

The specimen was obtained June 1, 1874, by Mr. S. F. Clark, at Savin Rock!, near New Haven, from the mouth of a squid (*Loligo Pealii*), whence the specific name. Two specimens "parasitic on young mullet" are in the Yale College Museum, collected at Fort Macon!, N. C., by Dr. H. C. Yarrow, which appear to belong to this species, showing that it is not confined to the squid.

Livoneca Leach.

Livoneca Leach, Dict. Sci. nat., tome xii, p. 351, 1818.

Head small, projecting in front over the bases of the antennulæ, which, like the antennæ, are short; legs all alike and armed with strong curved dactyli; body broad, oval, often obliquely distorted.

This genus is represented by a single species, in which the body is of a broadly oval form and depressed. All the legs are short and armed with strongly curved dactyli, and, in the natural position, are closely appressed to the ventral surface, which, however, is more or less exposed below along the middle.

Livoneca ovalis White (Say).

Cymothoa ovalis Say, Jour. Acad. Nat. Sci. Phil., vol. i, p. 394, 1818.

Dekay, Zool. New York, Crust., p. 48, 1844.

Livoneca ovalis White, Cat. Crust. Brit. Mus., p. 109, 1847. (*Lironeca*).

Harger, This Report, part i, p. 572 (278), pl. vi, fig. 29, 1874; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATE XI, FIG. 67.

The broadly oval, more or less distorted and unsymmetrical form of this Isopod serves to distinguish it from any other species yet recognized within our limits.

Body broad, oval, usually oblique, and not, as represented in part I of this report, pl. VI, fig. 29, with the sides of equal length. The legs, moreover, in that figure are in an unnatural position, as they are, during life, concealed beneath the body of the animal and appressed to the ventral surface, the first three pairs directed forwards and the last four pairs backward. The dorsal surface is moderately convex. The head is small, rounded in front, trilobed behind, the middle lobe much the largest, the two lateral lobes extending beyond the eyes, which are not conspicuous, small and broadly separated. Antennulæ (pl. XI, fig. 67*a*) widely separated at the base, with the first segment short and stout; the second longer and somewhat tapering; the third about as long as the first. These peduncular segments are somewhat flattened. The flagellum is longer than the peduncle, tapering and five-jointed, curved backward in the natural position, each segment bearing a row of short blunt setæ, near the distal end, on the inner curve. The antennæ (pl. XI, fig. 67*b*) are about as long as the antennulæ, with the first two segments short and stout, the next three more slender; flagellum three or four jointed, with the last segment imperfectly divided and tipped with a few short setæ. The maxillipeds are narrow, with the outer lamella partially united to the basal segment and the palpus tapering and two-jointed, tipped with a few short curved setæ, at least in young individuals. The mandibles are pointed; their palpi (pl. XI, fig. 67*c*) tapering from the base and composed of three segments of about equal length, the first subquadrate, the second tapering, the third nearly cylindrical.

The first thoracic segment is longest; the next three a little shorter and about equal; the fifth and sixth still shorter; the seventh shortest measured along the median line, which is usually a curved line except in young specimens. The anterior margin of the first thoracic segment is adapted to the posterior margin of the head and presents three sinuses, the middle one largest, for the median lobe of the head, and two smaller ones for the ocular lobes. The posterior margin of this segment is strongly convex backward throughout. In the succeeding segments

this convexity rapidly diminishes so that the fourth has nearly a transverse margin and the last three segments become concave behind in an increasing degree. The epimera are narrow and obtusely pointed behind, and do not surpass the posterior angle of the segment to which they are attached except in the last two segments. The first pair of legs (pl. XI, fig. 67*d*) are short and stout, the basal segment large but short; the next three segments short and with little motion on each other; the propodus stout and somewhat curved; the dactylus long, curved, and strong. The second and third pair of legs are much like the first, as are the four succeeding pairs, but somewhat larger and longer. The seventh pair (pl. XI, fig. 67*e*) have the basal segment about twice as long as in the first pair, and the succeeding segments are also proportionally longer than in the first pair, except the dactylus, which is slightly weaker and not longer than in the first pair.

The pleon tapers rapidly at the sides; its first five segments are subequal in length; the last segment forms about half its length, and is flat and broadly rounded behind. Uropods (pl. XI, fig. 67*f*) surpassing the telson with the basal segment, about as long as the rami and but little produced at its inner angle; outer ramus linear oblong, rounded at the end; inner ramus shorter and broader, oblique at the tip.

Length 17–22^{mm}, breadth 10–12^{mm}. These animals when preserved in alcohol are of a leaden color, with the posterior margins lighter.

They are often parasitic on the blue-fish (*Pomatomus saltatrix* Gill). The details figured on plate XI are from small specimens collected on young blue-fish at New Haven!, by Mr. F. S. Smith. Other localities are Thimble Islands!, Long Island Sound; Vineyard Sound!, Fish Commission 1871, one specimen among scup (*Stenotomus argyrops* Gill). A specimen was sent to the Museum in 1878, collected by Dr. T. H. Bean, from the gill of *Micropogon undulatus* caught at Norfolk!, Va., July 9, 1878.

Specimens examined.

Number.	Locality.	Parasitic on—	When collected.	Received from—	No. of specimens.	Dry- Alc.
2071	Norfolk, Va.	<i>Micropogon</i>	July 9, 1878	T. H. Bean	1	Alc.
2072	New Haven	Blue-fish.	— — —	F. S. Smith	15	Alc.
2073	Vineyard Sound	do	— — — 1871	U. S. Fish Com.	1	Alc.
2074	do	Scup	Aug. 17, 1871	do	1	Alc.
2075	Vineyard Sound	Blue-fish.	Sept. 2, 1871	U. S. Fish Com.	1	Alc.
2076				F. H. Bradley.	1	Alc.

XII.—ANTHURIDÆ.

Body elongate, cylindrical; mouth suctorial; legs ambulatory and prehensile, the first pair enlarged; first pair of pleopods thickened and crustaceous, protecting the following pairs; uropods articulated at the sides of the last segment, standing in a more or less vertical position and forming with the telson a sort of cup or flower at the end of the body.

This family is represented within our limits by three species belonging to as many genera, which, in addition to the characters given above, agree further in the following particulars: The body is elongated and vermiform, often more than ten times as long as broad, and of nearly uniform size throughout. The head and thoracic segments are all distinctly separated from each other, and the head and last thoracic segment are shorter than the intervening segments, which are subequal. Both pairs of antennæ are approximate at their bases, and the lower pair or true antennæ are short, not greatly surpassing the head in length. These organs have the basal segment short, the second segment flattened internally and adapted to its fellow of the opposite side, while above and externally it is excavated for the basal segment of the antennulæ. The mandibles are palpigerous, and the mouth parts are fitted for piercing and for suction.

In the first pair of legs the first, second, and penultimate segments are enlarged and thickened; the two intervening segments, merus and carpus, are short; the dactylus forms a curved finger tipped with a stout spine and capable of complete flexion on the robust propodus. In one or two of the succeeding pairs of legs the propodus may be slightly enlarged. The first three pairs of legs have the carpus, or antepenultimate segment, triangular, and their basal segments are directed strongly backward. In the last four pairs the carpus may be short, but is not triangular, and always distinctly separates the merus from the propodus; they are so articulated to the body that their basal segments are directed forward. The first three pairs of legs are articulated to the anterior part of the segment to which they belong, the next three near the middle of the corresponding segments, and the last pair near the posterior margin of the last segment.

The pleon is short, with the segments more or less consolidated, and the pleopods are of the normal number and form. The "operculum" is not formed as in the *Idoteidæ* and *Arcturidæ* of the uropods, but is nothing more than the enlarged and thickened first pair of pleopods, the greater part of it being formed of the external lamella, while the uropods have an entirely different and peculiar structure. They are biramous, and consist on each side of a more or less elongated, flattened, basal segment, so articulated as to lie alongside the telson, and bearing at the apex a terminal plate, the inner ramus, in the same plane with itself, while, on its upper side near the base, stands a more or less perpendicular, oval plate, the outer ramus. The telson is directed obliquely downward, and, with the uropods, forms a ciliated cup-like or flower-like termination of the cylindrical body, whence the name *Anthura*, from the Greek *ἄνθος*, a flower, and *ὄψα*, a tail.

The structure of the mouth in this family has been investigated by Prof. J. C. Schiödte, to whose original papers in the *Naturhistorisk Tidsskrift* I have not had access. The paper on *Anthura* is translated and partly condensed in the *Annals and Magazine of Natural History*,

where that author states that "next the *Cymothoidæ*, though as a type of a separate family, the genus *Anthura* must be placed."

The species of this family may be at once recognized by the peculiar cup-like termination of the body. This cup or "flower" is formed by the telson below, and the uropods at the sides and above; the outer rami of the latter organs being placed nearly vertically, and approaching each other on the median line above, where, however, the "flower" is more or less imperfect. Our three genera may be distinguished as follows: First five segments of pleon consolidated above, *Anthura* (p. 104); segments of pleon distinct, antennæ and antennulæ subequal, *Paranthura* (p. 108); segments of pleon distinct, antennulæ greatly enlarged in the male, *Ptilanthura* (p. 111).

Anthura Leach.

Anthura Leach, Ed. Encyc., vol. vii, p. "404" (Am. ed., p. 243), "1813-'14."

Antennulæ and antennæ short, subequal; thoracic segments not separated by constrictions; pleon with the five anterior segments consolidated above and resembling the last thoracic segment.

Our species of *Anthura* appears to agree in all generic characters with *A. gracilis* Leach upon which the genus was founded. In *A. polita*, however, the consolidated portion of the pleon is seen at the lower part of the sides to be composed of five consolidated segments, and bears the normal number of pairs of pleopods, while Bate and Westwood* say that "the four anterior segments are soldered closely together" in *A. gracilis*, and that "the pleopoda consist of, at least, four pairs of oval plates, strongly ciliated, on each side of the ventral surface of the basal segments of the tail." They had not, however, fresh specimens of the species, which is evidently closely related to ours.

The incubatory pouch of the females in the genus is confined to the third, fourth, and fifth segments, and is composed of three pairs of lamellæ, which overlap from behind forward, while the anterior margins of the first pair are united to the anterior part of the third segment.

Anthura polita Stimpson.

? *Anthura gracilis* Dekay, Zool. New York, Crust., p. 44, pl. ix, fig. 34, 1844 (not of Montagu and Leach).

Anthura polita Stimpson, Proc. Acad. Nat. Sci. Phil., vol. vii, p. 393, 1856.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

Anthura brunnea Harger, This Report, part i, p. 572 (278), 1874.

Verrill, This Report, part i, p. 426 (132), 1874.

PLATE XI, FIGS. 68 and 69.

This species is distinguished among its allies on our coast by the nearly complete union of the basal segments of the pleon, which have together the appearance of an eighth thoracic segment. The cup or "flower" at the end of the body serves to distinguish it from other Isopoda.

* British Sessile-Eyed Crustacea, pp. 157 and 160.

The body is smooth, shining and flattened above and broadly keeled in the males below. The head is a little broader than long, deeply excavated on each side of the front for the bases of the antennulæ, and produced at the sides. The eyes are small and lateral but distinct, and are placed on the outer side of the anterior prolongations of the head, about on a line with the bases of the antennulæ. They are too indistinct in the figure, and the eye was even omitted on the right side by the engraver. The antennulæ (pl. XI, fig. 68 *a*) consist of a tapering three-jointed peduncle and a very short flagellum. The first peduncular segment is the largest, and is flattened above and on the inner side; the second segment is smaller, cylindrical, and provided with a comb of hair-like setæ along its outer side; the third is smaller and shorter than the second; the flagellum consists of a single very small segment, with indications of a rudimentary second segment at the end, where it is also tipped with setæ. The antennæ (pl. XI, fig. 68 *b*) consist of a five-jointed peduncle, and a short flagellum much like that of the antennulæ. The basal segment of the peduncle is short; the second segment is the largest and is of peculiar shape, being excavated on the outer side to adapt it to the antennula, which lies in the groove thus formed, while the segment is bent upward and inward, and exposes a slender triangular area with the point backward, between, and on a level with, the antennulæ; the next three segments are sub-cylindrical and diminish in size, and are followed by one or two small flagellar segments tipped with setæ.

The maxillipeds (pl. XI, fig. 69 *a*) are thick and strong, and are composed of a basal quadrate segment, a little longer than broad, with its proximal external angle elided for the short, sub-triangular external lamella, and bearing two segments representing the palpus. Of these segments the first is but little smaller than the basal segment and is sub-quadrate, tapering a little at the sides beyond the middle. The terminal segment is straight at its articulation with the preceding, and nearly so along the inner side, then rounded in the remainder of the outline. The segments of the palpus are finely ciliated along their margins, except along the external margin of the first segment, where the ciliation nearly disappears; they are also provided with coarse setæ, a few of which occur on the maxilliped, near the outer distal angle. The inner maxilla (pl. XI, figs. 69 *b* and *b'*) is rather robust, and terminated by a strong tooth or spine, below which, on the inner side, is a row of smaller curved teeth. The mandibles are terminated by a horny tooth, below which is a serrulated lobe; the mandibular palpus is robust; the second segment much the longest and provided with stout setæ; the last segment with a comb of rather short setæ. The maxillipeds are of much firmer texture than the other parts of the mouth.

The first thoracic segment is the longest, and is closely adapted to the head behind so as to allow but little motion. The second segment is shorter but somewhat broader than the first, and is rather freely

articulated with it, and still more freely with the third; it is carinated below, but its articulations are much less free than in the next genus. The third, fourth and fifth segments are each about the length of the second; the sixth and seventh are progressively shorter. The first pair of legs (pl. XI, fig. 68 *e*) are quite robust and have but little freedom of motion, being directed forward under the head and hardly capable of further lateral extension than is shown in the figure of the animal. The basis and ischium are large and articulated so as to form a curve, bringing the legs forward; the merus is short; the carpus is triangular and extends along the side of the thickened propodus for about half its length, projecting like a tooth at the end; the propodus is ovate, much thickened and armed with a tooth near the middle of the palmar margin, along which it is ciliated, as is also the carpus; the dactylus is short and stout and tipped with a slender, curved, chitinous claw about as long as the dactylus itself. The figure (pl. XI, fig. 68 *e*) represents the inner surface of the leg, the merus being much less conspicuous on the outer side. The second and third pairs of legs are nearly alike and much more slender than the first pair. One of the third pair is represented on plate XI, fig. 68 *d*. In both these pairs of legs the carpus is small and triangular and wedged in between the merus and propodus, which meet above; the merus is a little larger in the second than in the third pair, and in both pairs it is provided with a few setæ at the upper distal angle and along the opposite or palmar side, where the carpus is also armed with setæ; the dactylus bears a few very short setæ. The remaining pairs of legs are rather more slender than the second and third, and the merus is separated from the propodus above by the carpus, which is, however, short. These legs are somewhat hairy, like the preceding pairs.

The anterior part of the pleon (pl. XI, fig. 68 *g*), consisting of the first five segments consolidated, appears much like an eighth thoracic segment a little longer than the seventh; traces of the sutures between the segments can be seen at the sides. The last segment is distinctly articulated, a little elevated dorsally, where it is also somewhat hairy; at the lower part of the sides it is covered by a slightly projecting lobe of the preceding segment, which extends over the proximal part of the basal segment of the uropods. Distally the terminal segment is depressed at a steep angle, and is in the form of a plate, ovate and ciliated at and near the tip, where it is obtuse; the sides are nearly parallel, and it is surpassed by the uropods, which consist, on each side, of a large basal segment, carinated on the outer side and toothed at the articulation with the outer ramus, obliquely truncated at the end, where it bears a short, obtusely-triangular, ciliated, inner ramus, or lamella, in the same plane as the basal segment. The outer ramus, or lamella, forms nearly a right angle with the basal segment, and stands upon its superior outer margin. This ramus is elongate reniform in outline, being notched below for the tooth on the basal segment, and is

ciliated along its free superior margin. The first pair of pleopods (pl. XI, fig. 68 *e*) are composed on each side of a short, quadrate basal segment supporting two rami, of which the outer is, like the basal segment, of firm texture, and acts as an operculum; in shape it is semi-oval, with the inner margin nearly straight, and is ciliated distally, and along the outer margin. The inner ramus is much smaller than the outer and of delicate texture, and, in the natural position, is covered and concealed by the outer ramus; it is slender, with nearly parallel sides, rounded at the tip, and not ciliated. In the males the second pair of pleopods (pl. XI, fig. 68 *f*) bears, near the middle of the inner margin of the inner ramus, a slender stylet, slightly surpassing the lamella to which it is attached.

The lamellæ forming the incubatory pouch of the females are of considerable antero-posterior dimensions, and the posterior widely overlap the anterior ones, while the anterior border of the first lamella is united with the third thoracic segment, to which the lamella belongs.

Length 15–18^{mm}; breadth 1.8–2^{mm}. The color is brownish above, mottled with yellowish or honey color, lighter underneath.

This species was described as new by the present author in the first part of this report under the name *A. brunnea*, but there appears to be no sufficient reason for regarding it as distinct from Dr. Stimpson's *A. polita*. It is apparently closely related to *A. gracilis* Leach, although sufficiently distinct according to Bate and Westwood's* description and figures. Those authors, however, seem to have had but very poor and imperfect material on which to base their work. They figure and describe the telson and uropods as truncated and crenulated, and Montagu,† in his original description of the species, says that "the body is terminated by five large caudal appendages truncated at their ends."

Kröyer's‡ descriptions and figures of *A. carinata* approach much more closely to the present species. His figure of the antennula considerably resembles ours, but in his description he gives as the relative lengths of the four segments composing it 11, 4, 3, 5. In our species the last or flagellar segment is much the shortest, as may be seen by the figure, plate XI, fig. 68 *a*. He further speaks of the telson as crenulated, while it is entire in *A. polita*, and his figure (Voy. en Scand., pl. 27, fig. 3 *n'*) shows no tooth-like projection or angle on the basal segment of the uropods, as seen in a lateral view, and the corresponding margin of the outer or superior plate is destitute of the notch shown in the lateral view of these organs on plate XI, fig. 68 *g*. The inner ramus or lamella of the first pair of pleopods is also figured as much larger and more expanded distally than in our species, for which see plate XI, fig. 68 *e*. Unfortunately I have had no European specimens for comparison.

* Brit. Sess. Crust., vol. ii, p. 160, 1868.

† Trans. Linn. Soc., vol. ix, p. 103, pl. v, f. 6, 1808.

‡ Naturhist. Tidssk., II, B. ii, p. 402, and Voy. en Scand., Crust., pl. xxvii, fig. 3 *a-o*, 1849.

This species was described by Dr. Stimpson from specimens taken at Norfolk, Va., and has since been collected by Professors Smith and Verrill at Great Egg Harbor!, N. J., in $1\frac{1}{2}$ fathoms shells and mud; by the U. S. Fish Commission in Long Island Sound!, especially at Noank Harbor!, among eel-grass (*Zostera marina*) and mud; off Block Island! in 17 to $19\frac{1}{2}$ fathoms sand, mud, and stones; at Vineyard Sound!, at low water and in sand, and in 1878 at Gloucester!, Mass., in mud and among algæ.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2077	Great Egg Harbor, N.J.	$1\frac{1}{2}$	Shells and mud....	Apr. —, 1871	Smith & Verrill	.....	Alc.
2078	Noank Harbor, Conn.	.....	Eel-grass.....	Aug. 23, 1874	U. S. Fish Com.	2	Alc.
2079	do	.....	Mud and eel-grass.	Aug. 29, 1874	do	2	Alc.
2080	do	.....	Mud	Aug. 23, 1874	do	2	Alc.
	Vineyard Sound	L. w.	Sand	Sept. 8, 1871	do	2	Alc.
	Squan Estuary, Gloucester, Mass.	.....	Mud	—, 1878	do	2	Alc.
	Gloucester, Mass.	.....	Mud and algæ....	—, 1878	do	1	Alc.

Paranthura Bate and Westwood.

Paranthura Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 163, 1866.

Pleon articulated, composed of six segments; thorax deeply constricted at each end of the second segment; antennulæ and antennæ subequal; palpus of maxillipeds three-jointed; inner maxillæ acicular.

The first character given above is the only one given by Bate and Westwood, who, however, mention that the pleon bears the normal number of pleopods; a character that would not distinguish our species from the other genera. The distinctly articulated flagellum of the antennulæ is provided with a partial whorl of bristles, which, however, forms only the most rudimentary approach toward the structure of those organs in the males of the following genus. The segmentation of the pleon is indistinct in the dorsal region, but is apparent at the sides when seen from above, and the pleon does not at all resemble an additional thoracic segment as in *Anthura*. Both pairs of antennæ are provided in our species with a distinctly articulated flagellum, and are of nearly equal length.

Paranthura brachiata Harger (Stimpson).

Anthura brachiata Stimpson, Mar. Inv. G. Manan, p. 43, 1853.

Verrill, Am. Jour. Sci., III, vol. v, p. 101, 1873; *ibid.*, vol. vii, pp. 42, 411, 502, 1874; Proc. Am. Assoc., 1873, pp. 350, 357, 1874; This Report, part i, p. 511 (217), 1874.

Whiteaves, Am. Jour. Sci., III, vol. vii, p. 213, 1874; Further Deep-sea Dredging, Gulf of St. Lawrence, p. 15, "1874."

Harger, This Report, part i, p. 573 (279), 1874.

Smith and Harger, Trans. Conn. Acad., vol. iii, p. 16, 1874.

Paranthura brachiata Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATE XI, FIG. 70.

The deep constrictions, by which the second thoracic segment is separated from the first and third, serve to distinguish this species from the allied forms on our coast, and the "flower" at the end of the pleon distinguishes it from other Isopoda.

Body moniliform, with evident segments; head narrower than, and about half as long as, the first thoracic segment, flattened and quadrate above, with a groove behind a raised anterior border, wedge-shaped below, deeply emarginate on each side of the projecting front above for the bases of the antennulæ; eyes lateral, not conspicuous, extending behind the emarginations. Antennulæ (pl. XI, fig. 70 *a*) with the first segment large but longer than broad, flattened above; second and third segments cylindrical; flagellum of twelve or more segments in adult specimens, with the first segment short, second twice as long and the longest segment of the flagellum, which tapers from the second segment and bears on the distal end of each segment an imperfect whorl of hairs. The antennæ (pl. XI, fig. 70 *b*) slightly surpass the antennulæ. They have the first segment short; the second flattened on the inner side, where it is usually in contact with its fellow of the opposite side, and excavated on the outer side above to accommodate the basal segment of the antennulæ; the third segment is short; the fourth and fifth longer and cylindrical. The flagellum consists of about twelve segments, tapers from the base, and is somewhat hairy. Both the antennæ and antennulæ are a little less developed and have one or two less segments in the females. The maxillipeds (pl. XI, fig. 70 *c*) are elongated, with a short, oval external lamella, and a two-jointed palpus. The large basal segment of the maxilliped projects on the inner side nearly to the end of the first segment of the palpus. The palpus has its segments of about equal length and provided with a few scattered bristles. The inner maxillæ (pl. XI, figs. 70 *d* and *d'*) are evident at the tip in an under view of the head; they are elongate and acicular, and minutely and sharply retro-serrate toward the tip. The three-jointed palpus of the mandibles is also conspicuous below; all three of its segments are short, and the last, which lies ordinarily between the bases of the antennæ, is flattened, oval, and provided with the usual comb of setæ.

The thorax is somewhat flattened above, carinate anteriorly below, and has the last segment much the shortest. The first segment is wider than the head and about twice its length, and is more closely united with it than are any of the thoracic segments with each other; it is strongly carinate below, especially on its anterior part, where the carina ends in a prominent tubercle; a much more slender carina bounds the flattened dorsal portion laterally. The second segment is separated from the first by a deep constriction, and is articulated so as to allow considerable motion, especially in a vertical plane; its antero-lateral angles are prominent in the form of low, rounded tubercles, and be-

tween them are two less evident tubercles on the front margin of the segment; the dorsal surface tapers behind, and is bounded laterally by carinæ; below, the segment is wedge-shaped, but not carinated; behind, it is separated from the third segment by a constriction not quite as pronounced as that in front. The third segment presents two rather more evident median tubercles in front on the dorsal surface, which is defined laterally by carinæ, fading away at about the middle of the segment; below, it is wedge-shaped and carinate in the males, but membranous along the median line in the females, as are the remaining segments more widely in that sex. In the males they are hard and chitinous throughout, rounded and scarcely wedge-shaped. The fourth segment is slightly longer than any of the others, and bears, near the anterior end of its dorsal surface, an oval depression with slight elongated elevations at each side. A similar structure occurs on the fifth and sixth segments, which are of decreasing length. The seventh is much the shortest thoracic segment, not being longer on the median line than the head; it is somewhat produced laterally.

The first pair of legs (pl. XI, fig. 70 *e*) are not as stout as in *Anthura polita*, and are more flexible; the carpus is the shortest segment, and is triangular, broader than long; the preceding segment, or merus, shows but little in an external view, but is more evident in an inner view, as shown in the figure, and is much broader than long; the propodus is much swollen proximally on its anterior or upper side; immediately in front of the end of the carpus it bears a stout tooth; the dactylus is strong, and tipped with a curved claw. In the second and third pairs of legs the carpus is triangular, but in the posterior pairs it is more elongated so as to distinctly separate the merus from the propodus.

The pleon is short, the telson triangular, acute at the apex. Uropods with the basal segment strongly carinate externally, terminal plate acutely triangular, proximal superior plate oval, curved and attached by its side, nearly meeting its fellow of the opposite side above. First pair of pleopods (pl. XI, fig. 70 *f*) with the external ramus semi-oval; internal ramus less firm in texture, ligulate, ciliated distally. Second pair of pleopods in the males (pl. XI, fig. 70 *g*) furnished with a slender stylet articulated at about the middle of the inner, posterior, lamella, and extending beyond its end. Both the lamellæ are crossed by a transverse suture just beyond their middle, at the point where the stylet is attached to the inner one.

Length 28^{mm}; breadth 2.2^{mm}; females about one-third smaller. The color is usually light yellowish brown, or sometimes somewhat darker, but not as pronounced as in the other members of the family, and nearly the same throughout.

From *P. norvegica* G. O. Sars* our species is distinguished by the eyes, which, though inconspicuous, are present. It lacks the tubercle de-

* Chr. Vid. Selsk. Forh., 1872, p. 88, 1873.

scribed and figured by Heller on the head of *P. arctica*,† and the flagellar segments of both pairs of antennæ distinguish it from *P. costana* Bate and Westwood.‡

This species was dredged by Dr. Stimpson "on a shelly and somewhat muddy bottom in twenty fathoms off the northern point of Duck Island," Bay of Fundy. It is rare south of Cape Cod, but was taken in Vineyard Sound! by the Fish Commission in 1871; also on St. George's Bank!, in 110 fathoms, mud and sand; Gulf of Maine!, down to 115 fathoms; Bay of Fundy!, down to 80 fathoms on muddy, shelly, and sandy bottoms; and off Nova Scotia!, 59 fathoms, pebbles, sand and rocks, and at other localities as detailed below. It was dredged by Mr. Whiteaves in 200 fathoms in the Gulf of Saint Lawrence, between Anticosti and the mainland of Gaspé.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Number of specimens.	Dry. Alc.
2081	Vineyard Sound. Gulf of Maine, east from Cape Ann 140 miles.	115	Gravel.	—, 1871 —, 1877	U. S. Fish Com. do	2	Alc. Alc.
	Gulf of Maine, southeast $\frac{1}{2}$ east from Cape Ann 13 miles.	53	Mud and stones.	—, 1878	do	1	Alc.
2082	Gulf of Maine, near Brown's Bank.	82	Rocks and barnacles.	—, 1877	do	2	Alc.
1365	George's Bank	110	Brown mud	—, 1872	Packard and Cooke.	2	Alc.
2083	Gulf of Maine, off Portsmouth 22 to 28 miles.	80-92	Soft mud	—, 1874	U. S. Fish Com.	3	Alc.
2084	Gulf of Maine	65	Mud, sand, and gravel.	—, 1874	do	2	Alc.
2087	Casco Bay, 20 miles southeast of Cape Elizabeth.	68	Mud	Aug. 12, 1873	do	1	Alc.
2088	Gulf of Maine, 27 miles off Portland.	90		Aug. 26, 1873	do	1	Alc.
2086	Casco Bay. Gulf of Maine, 17 miles southeast of Monhegan Island.	72	Brown mud	—, 1873 —, 1873	do do	10 3	Alc. Alc.
2095	Eastport, Me.			—, 1870	A. E. Verrill.	1	Alc.
2097	do.			—, 1872	U. S. Fish Com.	4	Alc.
2091	Bay of Fundy, between Head Harbor and Wolves.	60	Mud	Aug. 16, 1872	do	8	Alc.
2092	Off Head Harbor	75-80	Sand and shells.	—, 1872	do	8	Alc.
2093	Bay of Fundy.			—, 1872	do	1	Alc.
2094	do.	77		Aug. 16, 1872	do	1	Alc.
2096	Bay of Fundy, Grand Menan, New Brunswick.			—, 1870	A. E. Verrill.	3	Alc.
2098	Southeast from Cape Sable 18 to 22 miles.	56-59	Sand, gravel, and stones.	—, 1877	U. S. Fish Com.	2	Alc.

Ptilanthura Harger.

Ptilanthura Harger, Am. Jour. Sci., III, vol. xv, p. 376, 1878.

Antennulæ with the flagellum remarkably developed in the male, multiarticulate; second and succeeding antennular segments provided

† Denkschrift, Acad. Wiss. Wien., B. xxxv, p. [14] 38, pl. iv, figs. 9-12, 1875.

‡ Brit. Sess. Crust., vol. ii, p. 165, 1866.

with an incomplete, very dense whorl of fine slender hairs; pleon segmented, elongated; palpus of maxillipeds one-jointed.

The most important character of this genus is doubtless found in the structure of the antennulæ in the male sex. In the females the antennulæ are small, and the flagellum consists of a few slender rapidly tapering segments. They thus bear considerable resemblance to young specimens of *Anthura polita*, and being collected with them, were at first mistaken for them. They are distinguished by the larger and more conspicuous eyes, and by the more elongated and distinctly segmented pleon. In the presence of eyes our species differs from a form described by G. O. Sars, *Paranthura tenuis*, from near Stavanger, Norway, in which the males have a well-developed, eight-jointed and densely hairy or setiferous flagellum on the antennulæ.

Ptilanthura tenuis Harger.

Ptilanthura tenuis Harger, Am. Jour. Sci., III, vol. xv, p. 377, 1878; Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATES XI and XII, FIGS. 71-74.

Males of this species are at once recognized by the greatly developed antennulæ, resembling miniature bottle-brushes; females may be distinguished from the young of the other species by the conspicuous eyes; they are much smaller than the adults of the other species.

The body is smooth, flattened above, narrow at the middle, broadest at the base of the pleon. Head broader than the first thoracic segment and nearly as long, on the median line; longer than broad, narrowing to a point in front and much less acutely behind. The eyes are prominent, black, situated within the margin of the head and visible both above and below. The antennulæ in the males (pl. XII, fig. 74 *a*), when reflexed, attain the third thoracic segment; the first segment is large, but not longer than the second; the third is shorter than the second and followed by a short, subtriangular segment, which must be regarded as the first segment of the flagellum, although resembling the last peduncular segment much more than it does the succeeding or second flagellar segment; this segment is small at its base, but expands rapidly above and below and on the side which is next the body in the ordinary reflexed position of the antennula, and on these sides it bears, at its distal end, a fine and dense fringe of long slender hairs, which attain, when appressed, about the fifth following segment. Similar segments, to the number, in some specimens, of eighteen or twenty follow, forming an organ resembling a minute bottle brush or plume, whence the generic name. On one side, however, of the organ, which corresponds nearly with the outer or anterior side, according as the antennula is more or less reflexed, the whorl of hairs is interrupted. In the females (pl. XI, fig. 73) the antennulæ are shorter than the antennæ, with a short flagellum consisting of a small basal segment and a minute terminal one tipped with a few setæ. The antennæ (pl. XII, fig. 74 *b*) are short,

differing little in the sexes, hardly surpassing the peduncle of the antennulæ in the males, with a short three or four jointed flagellum bearing a few hairs near the tip. The maxillipeds (pl. XI, fig. 71*b*) have a quadrate basal segment, somewhat emarginate externally for the subtriangular external lamella, and bearing a single suboval terminal segment, or palpus, somewhat truncate and ciliated at the tip. The inner maxillæ (pl. XI, fig. 71*c*) are five-toothed, one tooth being strong and terminal and the other four lateral. The mandibles bear a single-jointed palpus.

The thoracic segments are subequal in length except the last, which is but little over half as long as the others, though broader behind than any of them. They are slightly narrower than the head and margined laterally with a somewhat raised ridge. The third, fourth, and fifth have an elongate oval depression on the median line near the anterior margin. The first pair of legs (pl. XI, fig. 72) have the segments well separated, the carpus nearly equilaterally triangular, the propodus moderately thickened, and the dactylus strong and tipped with a stout claw; the carpus and propodus are bristly on their palmar margins. The remaining pairs of legs are slender and nearly equal in size.

The pleon is about as long to the tip as the last three thoracic segments. The first five segments are consolidated along the dorsum, but distinct at the sides. Each segment rises into a low broad tubercle on each side of the median line. The last segment is about as long as the preceding five, and is elongate-ovate, and obtusely pointed behind. The basal plate of the uropods is about half as long as the telson; the terminal or inner lamella is triangular-ovate, and about equals the telson. The proximal or superior lamella is narrowly semi-ovate, with an emargination on the upper side near the tip. The first pair of pleopods (pl. XI, fig. 71*d*) are shorter than the abdomen, and have the outer plate semi-obovate and the inner shorter, with nearly parallel sides. The second pair of pleopods (pl. XI, fig. 71*e*) bear, in the males, a slender straight stylet, articulated below the middle of the inner lamella and slightly surpassing it. The outer lamella is imperfectly articulated near the middle.

Length 11^{mm}; breadth 0.9^{mm}; females about one-third smaller; color brownish and more or less mottled above, lighter beneath, margined with translucent at the sides, extending on the sides of the head as far as the eyes.

This species is rare on the coast. It has been taken by the United States Fish Commission, on muddy bottom, in Noank Harbor, Long Island Sound!; off Watch Hill!, R. I., in 18 fathoms, sand; and off Block Island!, in 17 to 19½ fathoms, sand, mud, and stones; at Waquoit, Vineyard Sound!, in sand, at low water, September 8, 1871; in Casco Bay!, sand and mud, from 9 fathoms, in 1873, and by Prof. A. E. Verrill, at Grand Menan, in the Bay of Fundy! in 1870.

It is nearly related to and doubtless congeneric with *Paranthura*

tenuis G. O. Sars,* but is at once distinguished by the presence of eyes, from which character, as distinctive, the name *P. oculata* might be applied to our species if a new trivial name should be thought necessary.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
2099	Noank Harbor, Conn.	.....	Mud	— —, 1874	U. S. Fish Com	1	♂	Alc.
2104	do	.....	.....	— —, 1874	do	1	♂	Alc.
2100	Off Watch Hill, R. I.	18	Sand	July 31, 1874	do	1	♂	Alc.
2105	Off Block Island	17-19½	Sand, mud, and stones.	— —, 1874	do	1	♂	Alc.
2103	Vineyard Sound, Mass.	L. w.	Sand	Sept. 8, 1871	do	1	♀	Alc.
2101	Casco Bay, Me.	.....	Mud	July 16, 1873	do	1	♂	Alc.
2102	do	9	Sand and mud	Aug. 4, 1873	do	1	♂	Alc.
2106	Bay of Fundy, Grand Menan.	.....	.....	— —, 1870	A. E. Verrill	1	♂	Alc.

XIII.—GNATHIIDÆ.

Thorax with only five pairs of legs of the normal form in the adults, and apparently consisting of only five segments; antennulæ and antennæ short, with evident distinction into peduncle and flagellum; mouth organs suctorial in the larval state, more or less aborted in the adult; pleon with its segments distinct, bearing the normal number of pleopods; uropods inserted at the sides of the base of the last segment, biramous and resembling the pleopods but of firmer texture.

This family is represented on our coast by a number of forms, all of which, however, appear to be referable to a single species, in which, contrary to what is ordinarily observed in the order, a considerable transformation occurs, especially in the males, after the young leave the incubatory pouch, and before they reach the adult form. The sexes are very unlike at maturity, but in both the thorax may be seen, by a little inspection, to consist in reality of seven segments, of which the first is united with the head, but separated from it by a sutural line near its posterior margin, while the seventh is small and resembles the segments of the pleon, which appears as if consisting of seven segments. The last thoracic segment does not bear a pair of legs. The head is large in the adult male and armed with a powerful pair of curved jaws projecting strongly forward and curved upward. The antennulæ are short and widely separated at base. The antennæ are inserted nearly below them.

The five pairs of pediform legs are ambulatory and nearly alike throughout; the propodal segments are somewhat elongate, and the dactyli weak. All the thoracic segments except the first are distinct in the male, and all are distinct in the larval forms, but the fourth and fifth

*Chr. Vid. Selsk. Forh., 1872, p. 89, foot-note, 1873.

(third and fourth free segments) are indistinctly separated in the adult females.

The pleon is much alike in both sexes and the young, and consists of six distinct segments, each of which bears a pair of appendages. The first five pairs of these appendages, or pleopods, are carried beneath the pleon and subserve the purposes of respiration, while they are also used in swimming. They consist of a short basal segment supporting two rami, ciliated at the tip in the young. The uropods are directed backward and are of firmer texture than the pleopods. They are ciliated near the tip.

Only a single species has yet been recognized within our limits, and the male, female, and young will be described under the specific name.

The striking sexual differences in this family have caused much confusion, the males having been referred to one genus (*Anceus*), and the females to another (*Praniza*), and even these genera have been referred to different tribes or subfamilies. The true relationship of these forms, long ago suspected by Leach, was first made known by M. Hesse,* who, however, seems not to have stated it very clearly and perhaps did not correctly apprehend it at first. His descriptions, however, of the females of *Anceus* apply to what had previously been regarded as the female of *Praniza*, although he says in the same paper that *Praniza* is only the larval state of *Anceus*, which is true only of the young, or larval forms, or the then supposed males of *Praniza*. This family has been further investigated by Bate, Westwood, and Dohrn, to whose writings the reader is referred. It may be here remarked that Bate and Westwood in their account of the structure of *Anceus*, in the second volume of the British Sessile-Eyed Crustacea, appear to have overlooked the last thoracic segment, and suppose that either the first or second segment must be wanting. Dohrn calls attention to the rudimentary (or embryonic) condition of the seventh thoracic segment as the one missing to complete the normal number, but describes and figures† as “untere” and “obere Mundextremität” (“verwandeldes erstes” and “zweites Gnathopoden Paar”) what I regard as the maxillipeds and first pair of thoracic legs, or, according to Spence Bate’s terminology, which Dohrn seems to have misapprehended, the maxillipeds and the first pair of gnathopods. The second pair of gnathopods are pediform as usual in the Isopoda, and are the first of the five pairs of legs. Of the five pairs of pereopods normally present, only four are developed in the Gnathiidae. The family is thus remarkable in the order both for the transformations undergone in its development, and for the retention after all of an embryonic feature.

Having discarded the names *Anceus* and *Praniza* for reasons given below, I have also rejected the family name *Anceidae* and substituted for it a name, suggested by Bate and Westwood and derived from that

*Ann. Sci. nat., IV, tom. ix, p. 106, 1858.

†Zeit. Wiss. Zool., xx, taf. vii, figures 24 and 25.

of the typical genus. The name *Anceida* should perhaps be restored in case Risso's species should not prove to be congeneric with *Gnathia termitoides* Leach, *Cancer maxillaris* Montagu.*

Gnathia Leach.

Gnathia Leach, Ed. Encyc., vol. vii, p. "402" (Am. ed., p. 240), "1813-14."

Praniza Leach, MSS.

Anceus Risso, Crust. de Nice, p. 51, 1816.

Head very large and quadrate in the male, smaller and subtriangular in the female; first pair of legs operculiform in the male, subpediform in the female; pleon much narrower than the thoracic segments, with nearly parallel sides, and a sharply triangular telson.

The name *Anceus* Risso, which has been used by modern writers for this genus, ought, according to all rules of priority, to give way to *Gnathia* Leach, as acknowledged by Bate and Westwood,† who, however, hesitated to restore the name on account of Kirby's coleopterous genus *Gnathium*. While the undoubted priority of the name is a sufficient reason for its re-establishment, it may be worth while to add that *Gnathia* was not restricted by Dr. Leach to either sex alone, as that author had the sagacity to "suspect that *Oniscus coeruleatus* Montagu [*Praniza coeruleata* Desm.] was the female" of *Gnathia*, and, as far as I am aware, did not publish a generic name for the *Praniza*-form, although the name *Praniza* was used by him as a manuscript name, and as such appears to have been published by Latreille in the Encyclopédie Méthodique, which I have not been able to consult.

Gnathia cerina Harger (Stimpson).

Praniza cerina Stimpson. Mar. Inv. G. Manan, p. 42, pl. iii, fig. 31, 1853.

Packard, Mem. Bost. Soc. Nat. Hist., vol. i, p. 296, 1867.

Verrill, Am. Jour. Sci., III, vol. vi, p. 439, 1873; vol. vii, pp. 38, 41, 411, 502, 1874; Proc. Am. Assoc., 1873, pp. 350, 354, 358, 362, 1874.

Anceus americanus, Stimpson, Mar. Inv. G. Manan, p. 42, 1853.

Gnathia cerina Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATE XII, FIGS. 75-79.

It will be convenient first to describe the male of this species and then the female and larval forms. The powerful and prominent jaws in front of the large quadrate head of the males of this small Isopod serve to distinguish it from any other on our coast.

The shape of the body is well described by Dr. Stimpson, as "regularly rectangular, abruptly narrowed at the commencement of the abdomen, which has the appearance of another very small rectangle set into the first, and of only one-third its width." It is somewhat bristly hairy, and much tuberculated and roughened above, especially on the lateral portions of the head and on the anterior thoracic segments. The head is broader than long, depressed medially in front and produced into a rounded lobe between the projecting upturned jaws. The eyes are small

*Trans. Linn. Soc., vol. vii, p. 65, pl. vi, fig. 2, 1804.

†Brit. Sess. Crust., vol. ii, p. 169.

and placed well forward at the sides of the head. The antennulæ (pl. XII, fig. 76 *a*) are shorter than the head and slender, sparingly hairy, with a short, few-jointed flagellum. The antennæ (pl. XII, fig. 76 *b*) are also slender, with the first segment apparently composed of two united; the second segment short; the third and fourth longer, nearly cylindrical and followed by a slender few-jointed flagellum. The jaws (pl. XII, fig. 76 *c*) are elongate and turned upward at the apex, irregularly and bluntly toothed near the base within, and somewhat carinate on the outer side near the middle, the carina ending rather suddenly in a tooth-like process of the jaw as seen from above. The under surface of the head is deeply and broadly grooved longitudinally, and this groove is covered by what appear to be the transformed first pair of thoracic legs (pl. XII, fig. 76 *d*). They are in the form of a semi-oval plate on each side, attached near the base of the external side and strongly convex and ciliated on the inner side, where they overlap. This plate is truncated at the apex, where it bears a small oval lamella; on the surface of the large plate are three large, oval, semi-transparent areas. Within these plates is another pair of organs, consisting of a large basal segment and an articulated series of four flattened ciliated segments. These may be regarded as the maxillipeds, with a four-jointed palpus.

The first thoracic segment is indicated above only by a faint sutural line near the posterior margin of the large head. It is followed by five very distinct segments, of which the first two are perhaps most distinct, short, and strongly tuberculated, especially along their posterior margins. The third free segment is broader than the second, square at the sides, with two broad lateral elevations. The fourth free segment is somewhat rounded in front, with its chitinous integument apparently not calcified along the median line. The fifth free segment is narrower than the preceding and produced at the sides around the small last thoracic segment and the base of the pleon. The legs are nearly alike throughout, somewhat hairy and spiny.

The pleon is slightly dilated at the middle, with the angles of the segments salient. The last segment is acutely triangular, ciliate behind, surpassed by the uropods, which are also ciliated with a few bristles; both rami are slender, the inner a little broader than the outer. The pleopods (pl. XII, fig. 78 *e*) consist of two slender elongate lamellæ, the inner longer than the outer, attached to a basal segment and not ciliated in the adults of our species.

Length 4.4^{mm}; breadth 1.3^{mm}; color dirty yellowish brown above, lighter below. This form is *Anceus americanus* Stimpson.

The adult female (pl. XII, fig. 77) differs from the male principally in the following characters: The body is smooth and tapers behind and before, but is much swollen medially, where the segmentation becomes obscure, and the thoracic region seems converted into a sack for the reception of the eggs, plainly to be seen through the transparent integument. The head is comparatively small and subtriangular, emarginate

in front. The eyes are placed farther back, and the large conspicuous jaws are wanting. Under the head, the first pair of legs (pl. XII, fig. 78 *a*) are slender, three-jointed with a minute terminal segment, and lie upon a delicate membranous plate on each side; within these are a pair of organs resembling what I have regarded as the maxillipeds of the male.

The first two free thoracic segments are short and curved somewhat around the head; the next two segments are much enlarged and nearly coalescent, and the fifth free segment is nearly similar in form to that of the males. The last thoracic segment is short and small and, as in the male, resembles a segment of the pleon.

The pleon (pl. XII, fig. 78 *c*) differs little from that of the male, but the angles of the segments are less salient.

Length 3-4^{mm}; breadth 1.5^{mm}. Color "pale yellowish or waxy." Dr. Stimpson was "inclined to consider" this form as the female of *Praniza cerina*.

The larval forms bear a much greater resemblance to the female than to the male but are more slender than either, the thorax being, in the smaller specimens, but little broader than the pleon. The head is broad, with large prominent eyes, and is distinct from the first thoracic segment, its posterior margin being truncated. The antennulæ have a short basal segment to the flagellum, which is followed by an elongate cylindrical segment forming about half the length of the flagellum, but bearing at its end a few short segments. The mouth organs project beyond the head, giving it an acute outline, and are evidently formed for piercing and suction. The large jaws of the adult males are, of course, wanting. The maxillipeds are slender and elongated.

The first pair of thoracic legs (pl. XII, fig. 78 *b*) are elongate, with the normal number of segments, a triangular carpus, and a strong curved dactylus, reminding one of the legs of the *Cymothoidæ*. The first thoracic segment is small and short and well separated from the following segments. The next two segments are quite distinct in all the forms, but usually the fourth, fifth, and sixth segments are united much as in the adult female. These forms appear to be the young females, and were described by Dr. Stimpson under the name of *Praniza cerina*; more rarely, however, specimens are found in which all the thoracic segments are distinct and somewhat resemble those of the adult male, but with their peculiarities less marked (pl. XII, fig. 79).

The pleon resembles that of the adults, but is not suddenly much narrower than the thorax. The pleopods as well as the uropods are ciliated at the tip (pl. XII, fig. 78 *d*).

Both these forms of young were taken from the body of a sculpin in the Bay of Fundy in 1872, and, when fresh, their bodies were bright red. In alcohol they fade to a waxy yellow.

Adult males of this species greatly resemble *Anceus elongatus* Kröyer,

but his *Praniza Reinhardi* differs in its proportions of the antennary segments from *G. cerina*.

This species was described by Dr. Stimpson from females "dredged on gravelly and coralline bottoms in 20-30 fathoms in the Hake Bay," and males "dredged on a sandy bottom in 10 fathoms off Cheney's Head," Grand Menan, in the Bay of Fundy. It has been collected by the U. S. Fish Commission in Massachusetts Bay!, off Salem, 22-50 fathoms, gravel and soft mud; Gulf of Maine!, at several localities; Casco Bay!, 50 fathoms; Bay of Fundy!, in many localities, 10 to 60 fathoms, rocks, stones, and mud, and young specimens have been taken adhering to codfish and the sculpin. It was dredged by Mr. J. F. Whiteaves in the Gulf of St. Lawrence!, in 220 fathoms, mud. Further details in regard to localities are given in the subjoined table.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
	Massachusetts Bay, 3 miles S. E. Nahant.		Mud	Aug. 31, 1879	J. H. Emerton.	3	♀	Alc.
2108	Massachusetts Bay, off Salem E. S. E. 9 to 11 miles.	22	Gravel, stones.	—, 1877	U. S. Fish Com.	3	.....	Alc.
2109	Massachusetts Bay, off Salem E. S. E. 8 to 9 miles.	33	Mud	—, 1877	...do	1	♀	Alc.
2121	Massachusetts Bay, off Salem E. S. E. 6 to 7 miles.	25-26	Gravel, stones.	—, 1877	...do	1	♀	Alc.
2110	Massachusetts Bay, off Salem E. S. E. 11 to 13 miles.	45-50	Mud	—, 1877	...do	12	♂ ♀	Alc.
	Gulf of Maine, S. E. ½ S. from Cape Ann, 6 to 7 miles.	54-60	Sand, mud....	—, 1878	...do	12	♂ ♀ y.	Alc.
2107	Gulf of Maine between Cape Ann and Isle of Shoals.	27-36	...do	—, 1874	...do	1	♀	Alc.
2111	Casco Bay	50	.....	Aug. 6, 1873	...do	2	♂ ♀	Alc.
2112	...do			—, 1873	...do	1	♂ ♀	Alc.
2113	...do			—, 1873	...do	10	♂ ♀	Alc.
2115	Eastport, Me.	10-20	Rocky	—, 1872	...do	3	♂ ♀	Alc.
2117	...do			—, 1872	...do	3	♂ ♀	Alc.
	...do			—, 1868	A. E. Verrill	3	.....	Alc.
2114	Bay of Fundy		On sculpin, &c.	—, 1872	U. S. Fish Com.	12	y.	Alc.
2116	...do	25-30		—, 1872	...do	5	♂ ♀	Alc.
2118	...do			—, 1872	...do	5	♂ ♀	Alc.
2119	Bay of Fundy, off Head Harbor.	40		—, 1872	...do	6	♂ ♀	Alc.
2122	Bay of Fundy	60		1870-'72	A. E. Verrill.	00	♂	Alc.
	Off Sable Island	160	On <i>Lophohelia</i> .	—, 1878	U. S. Fish Com.	4	♂	Alc.
2120	Gulf of Saint Lawrence	220	Mud		J. F. Whiteaves	1	y.	Alc.

XIV.—TANAIDÆ.

Respiration cephalothoracic, taking place in a cavity beneath the walls of the united head and first thoracic segment; eyes, when present, articulated; antennular flagellum single; first pair of legs enlarged and more or less perfectly chelate; pleopods natatory, ciliated, not branchial; uropods, terete, terminal, with at least one jointed ramus.

This family differs widely from all the other Isopoda, and indeed from all the sessile-eyed Crustacea, in the structure of the respiratory organs, and in the fact that the eyes, when present, are articulated with the head, or stalked, though without any proper pedicel.

I have seen species of only two genera, *Leptochelia* Dana and *Tanais* Audouin and Edwards, from within our limits. These genera are, by some authors, united under the name *Tanais*, but there seems to be ample reasons for separating them. While they agree in many characters, they differ widely from *Apseudes* Leach, which should probably be regarded as belonging to a different family not represented on our coast, and is accordingly not included in the above diagnosis.

Our representatives of the *Tanaidæ* may be further characterized as follows: The body is subcylindrical and elongated, from four or five to at least eight times as long as broad. The head and first thoracic segment are covered by the large cephalothoracic shield, which tapers somewhat in front, and is dilated behind. Its postero-lateral regions are occupied on each side by the branchial cavity, opening behind by a vertical slit, and in front by a nearly horizontal orifice. During life a lash-like organ can be seen through the body wall, in constant vibration, propelling a stream of water from behind forward through the cavity. The eyes, when present, are distinctly articulated with the head, and in the males are generally larger and more coarsely granulated than in the females. They are absent in one of our species, as in the one mentioned by Willemoes-Suhm from 1,400 fathoms in the Atlantic Ocean, off the North American coast, obtained by the Challenger expedition. They are described as indistinct in other foreign species. The antennulæ are inserted close together immediately below the vertex of the head and between the eyes. They are robust at base, and in the males may be elongated, but in the females are short, with only three or four segments and a minute rudiment of a flagellum. In neither sex have they any trace of the secondary flagellum seen in *Apseudes*. The antennæ are more slender than the antennulæ, and inserted almost directly beneath them. They are five-jointed, with the first and second segments short, the third larger and longer, the fourth and fifth slender and cylindrical, and, like the antennulæ, with indications of a flagellum. The antennæ, like the antennulæ, are tipped with bristles and bear a few scattered similar bristles on their segments.

The mouth organs are aborted in the males, at least in the genus *Leptochelia*, but in the females the mouth is protected below by a well-developed pair of maxillipeds, of which the basal segments meet at an angle forming a keel on the under surface of the head. The palpi of the maxillipeds are four-jointed, and armed with strong cilia; the last segment is strongly flexed on the penultimate. The inner maxillæ are spiny, and have the outer lobe reflexed and bearing elongated cilia at the tip. The mandibles are strong, destitute of palpi, and armed with one or two dentigerous lamellæ at the apex and a strong molar process.

The first pair of legs are robust, and in the males may be large and much elongated; they are in both sexes of our species powerful organs of prehension, being strongly chelate. Like the remaining pairs of legs, they have only five movable segments, unless an articulated spine at the extremity of the fifth segment is to be regarded as the true dactylus. On the other hand, the basal segment in many specimens presents indications of a short segment at its distal end, as if really consisting of the united basis and ischium. If this latter supposition be the true one, the hand of the first pair of legs is formed, as might be expected, of the propodus and the dactylus; the propodus is thickened and provided with a digital process stronger than the curved dactylus, which closes against it; the digital process bears toward the tip a few stout, bristly setæ. These legs are attached to the under side of the united head and first thoracic segment below the branchial cavity, and are directed forward. They are capable of but little lateral motion, and are nearly in contact below, especially toward their bases, which cover and partly conceal the organs of the mouth and the bases of the antennæ. The second pair of legs are very slender in comparison with the first, and are more slender than those that follow. Their basal segments are flattened, somewhat elongated, and usually bent with the convexity outward, in adaptation to the basal segments of the first pair of legs, which they partly embrace. The last three pairs of legs have their basal segments swollen.

The pleon consists, in our species, of five or six segments, and bears three or five pairs of strongly ciliated pleopods of the ordinary form, and fitted for swimming, and also a pair of uropods, consisting of a large basal segment bearing one or two rami. This ramus, or the inner one when there are two, is articulated and composed, in our species, of from two to six segments. The outer ramus may also consist of more than one segment. Like the antennulæ and antennæ, the uropods are provided with setæ, which are often elongate.

In the young the seventh pair of legs are not developed, and, according to Müller, the pleopods are likewise wanting and the uropods have less than the adult number of segments.

This family has been the subject of special research by Fritz Müller, Spence Bate, Dohrn, and others, to whose writings reference may be had for further description of their anatomy and development. Their proper place among the Crustacea cannot be regarded as settled, though the opinion of Fritz Müller that they represent an ancestral type of Isopoda is probably the best offered as yet. According to Dohrn, they present in their development affinities with *Asellus*, *Ligia*, and *Cuma*. Gegenbaur associates his *Tanais* with the *Podophthalma* rather than the *Edriophthalma*.

Our species of this family are sharply divided into two genera, for which I have, after some hesitation, adopted the names *Tanais* Aud. and Edw. and *Leptochelia* Dana. I have not been able to see Audouin and Edwards' *Résumé d'Entomologie*, in which the genus *Tanais* is said to

have been established, without description, in 1829. In the *Précis d'Entomologie*, by the same authors, is a figure (pl. xxix, fig. 1), apparently the same as that in the *Résumé*, which is there called *Tanais de Costa*. Latreille,* in 1831, characterized the genus, basing it upon *Gammarus Dulongii* Aud., figured by Savigny. Westwood,† in 1832, proposed for the same species the name *Anisochirus*, without, however, mentioning any characters. In 1836, Templeton‡ described and figured, with evident care and accuracy, a species of this family under the name *Zeuxo Westwoodiana*. This species has, according to his figure, six segments in the pleon. Edwards, in his general work, *Histoire naturelle des Crustacés*, figures and describes *Tanais Cavolinii* (tome iii, p. 141, pl. 31, fig. 6), and refers the figure in the *Précis d'Entomologie* to that species. In 1843, Rathke§ described and figured *Crossurus vittatus* as a new genus and species allied to *Apseudes* and *Tanais*, but there do not seem to be any characters of importance to separate it from *T. Cavolinii* Edw., and, indeed, Bate and Westwood are inclined to regard them as identical species. If, however, *T. Dulongii* be regarded as the type of the genus, there appears to be nothing but the clothing of the basal segments of the pleon to separate the two genera, and this character seems of no more than specific value, since *T. Dulongii* is described by Bate and Westwood as possessing the peculiar "branchial appendages" at the base of the fifth pair of legs. These appendages are doubtless incubatory sacs, similar to those of *T. vittatus*.

For the second genus I have hitherto used the name *Paratanais* Dana, on the ground that *Leptochelia* of the same author, although having priority, was founded upon the characteristics of the male sex. The type-species, however, of this genus, *L. minuta*, possesses all the characters of *Paratanais* that could occur in the male. *Leptochelia Edwardsii* Dana, *Tanais Edwardsii* Kröyer, moreover, belongs to the same genus, and I have adopted the name for both sexes.

The minute species, by which this family is represented on our coast, may be readily recognized by the proportionately large and strong chelate first pair of legs articulated to the united head and first thoracic segment. The two genera are distinguished by the number of segments in the pleon, which are five, with three pairs of pleopods in *Tanais* (p. 122), and six, with five pairs of pleopods in *Leptochelia* (p. 126).

Tanais Audouin and Edwards.

Tanais Audouin and Edwards, "Résumé (not Précis) d'Ent., p. 182 (without description, 1829), pl. xxix, fig. 1" (B. & W.); *Précis d'Entomol.*, p. 46, pl. xxix, fig. 1.

Edwards, *Hist. nat. des Crust.*, tom. iii, p. 141, 1840.

Crossurus Rathke, *Fauna Norwegens*, p. 35, 1843.

Antennulæ and antennæ simple; mandibles without palpi; pleon composed of five segments bearing three pairs of ciliated pleopods below,

* Cours d'Ent., p. 403.

† Ann. Sci. nat., tome xxvii, p. 330, 1832.

‡ Trans. Ent. Soc., vol. ii, p. 203, 1836.

§ Fauna Norwegens, p. 35.

and a pair of simple uropods behind; eggs incubated in sacs attached near the bases of the fifth pair of legs of the females.

This genus is distinguished from the next by the structure of the pleon and the uropods as given above, and the females are, when carrying eggs or young, distinguished from all the other Isopoda by the wart-like, or sac-like, appendages of the fifth thoracic segment. Usually a small wart-like appendage is visible on each side of the inferior surface of the thorax just within the bases of the fifth pair of legs, but the size of these organs varies greatly, and in some specimens they become distended with eggs, extended lengthwise with the body and more or less coalescent, so as to form the large, bilobed incubatory pouch, as figured by Rathke. This pouch is, however, attached only to the fifth segment.

The presence of a peculiar appendage to the fifth pair of legs in this genus has been noted by various authors. Bate and Westwood figure, in the second volume of the British Sessile-Eyed Crustacea, page 122, a leg of the fifth pair with the attached pouch, which they "regard as a branchial sac similar to those existing in the Amphipoda, and consequently affording a proof of the nearer relationship of *Tanais* with that order than is possessed by any other isopodous animal." They remark further that "this appendage is wanting in some specimens, and its variable existence is probably a character of specific distinction in the group." Those authors have not, however, separated *T. vittatus* into two species on this character. Stebbing* mentions a specimen with eggs "as described by Rathke." Macdonald† figures a female with an incubatory pouch, which he briefly describes as "a membranous expansion or saccule under the thorax."

Rathke's original description is as follows: "Beide Exemplare, die ich untersuchen konnte, waren Weibchen und trugen Eier unter dem Thorax. Diese aber, die übrigens verhältnissmässig ziemlich gross waren, lagen nicht, wie bei *Idothea*, *Ligia* und vielen andern Isopoden, in einer zum Theil aus Schuppen bestehende Brüthöhle eingeschlossen, sondern bildeten zwei länglichovale, dicht neben einander liegende und an der Oberfläche nur wenig unebene Massen von ziemlich beträchtlicher Grösse. Jede von ihnen war zusammengesetzt aus den Eiern und einer durchsichtigen eiweissartigen Substanz, die um jene herumgegossen war, sie wie ein Kitt zusammen hielt, und sie zugleich auch an die Bauchseite des Leibes befestigte. Es zeigten demnach jene Massen ganz dieselbe Zusammensetzung, wie die sogenannten Eiertrauben der Cyclopiden, Lernæaden und Branchiopoden." Rathke, having had only two specimens, does not appear to have perceived the attachment of these masses at the bases of the fifth pair of legs, and of course had no opportunity to see them in various stages of development. A specimen belonging to this genus and measuring 17 millimeters in length was obtained at Ker-

* Ann. Mag. Nat. Hist., IV, xvii, p. 73, 1876.

† Trans. Linn. Soc., II, Zool., vol. i, p. 69, pl. xv, fig. 1, 1875.

guelen Island by Willemoes-Suhm,* who describes the sacs attached to the fifth thoracic segment and attaining, as the young develop, a diameter of three to four millimeters.

Tanais vittatus Lilljeborg (Rathke).

Crossurus vittatus Rathke, Fauna Norwegens, p. 39, pl. 1, figs. 1-7, 1843.

Tanais tomentosus Kröyer, Naturhist. Tidssk., B. iv, p. 183, 1842; *ibid.*, II, B. ii, p. 412, 1847; Voy. en Scand., Crust., pl. xxvii, figs. 2 a-q, "1849."

Lilljeborg, Öfvers. Vet.-Akad. Förh., Årg., viii, p. 23, 1851.

Meinert, Crust. Isop. Amph. Dec. Daniæ. p. 86, "1877."

Tanais hirticaudatus Bate, Rep. Brit. Assoc., 1860, p. 224, 1861.

Tanais vittatus Lilljeborg, Bidrag Känn. Crust. Tanaid., p. 29, 1865.

Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 125, 1866.

Stebbing, Trans. Devon. Assoc., 1874, p. (7), and 1879, p. (6); *Ann. Mag. Nat. Hist.*, IV, vol. xvii, p. 78, 1876.

Verrill, Am. Jour. Sci., III, vol. x, p. 33, 1875.

Macdonald, Trans. Linn. Soc., II, Zool., vol. i, p. 67-70, pl. xv, 1875.

Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATE XIII, FIGS. 81, 82.

This species is at once recognized among our Isopods by the pleon, which is beset with bristly hairs at the sides, and crossed by two rows of similar hairs near the posterior margins of its first two segments.

The body, though small, is rather robust, the length being about five times the breadth, which is greatest at the first free, in reality the second, thoracic segment. The head and united first thoracic segment is short, not longer than broad. The eyes are distinctly articulated and much less in diameter than the bases of the antennulæ. The antennulæ are shorter than the head and first thoracic segment, and are composed of three segments, of which the first is longer than the other two together, while the second and third are of about equal length; the third segment is terminated by one or two rudimentary segments, surmounted by a tuft of straight bristly setæ. Similar setæ arise from the terminal portions of the two preceding segments. The antennæ are as long as the antennulæ, but more slender, and consist of a five-jointed peduncle, somewhat setose like the antennulæ, and terminated by a rudimentary flagellum beset with setæ. The basal plates of the maxillipeds are ciliated externally, and meet each other on the median line so as to form a keel narrowing backwards; distally they become thicker and bear a four-jointed palpus, of which the second and third segments are dilated internally and ciliated, and the fourth is spatulate and ciliated at its extremity. The inner maxillæ have one of the lobes of the usual form and position, and armed with short, curved spines at the tip, while the other is bent backward and bears several elongated cilia at the tip, and by its constant motion urges a stream of water through the branchial cavity.

The first pair of legs are much enlarged and extend, in their natural position, beyond the head, and the "hand" is ordinarily directed nearly downward. The digital process of the propodus bears a broad lobe on its inner side, and an acute tooth at its extremity; at the side of the lobe

*Zeit. Naturges., B. xxiv, p. xvii, 1874.

is a row of setæ; the dactylus is strong, with an obtuse tooth on its inner margin. In the second pair of legs the dactylus is rather robust and tapers strongly. In the succeeding pairs of legs the dactyli become curved, and, in the posterior pairs, hooked and armed with a comb of slender teeth, while the three preceding segments are also armed with slender teeth or spines at their distal ends. The constrictions between the thoracic segments are well marked, giving the body a somewhat moniliform appearance. In breeding females, a pair of warts, or sacs of greater or less size are found attached to the under surface of the fifth thoracic segment, and containing eggs or young, according to their stage of development. These sacs often, if not usually, coalesce more or less perfectly before maturity.

The first three segments of the pleon are not narrower than the last thoracic segment, and are strongly margined, or tufted, at the sides with plumose hairs. These hairs are continued in two transverse rows, one upon the first and another on the second segment near their posterior margins, across the back of the pleon. This character is only imperfectly shown in the figure, where the transverse rows of hairs should have been more strongly indicated. The last two segments of the pleon are suddenly narrower than the first three. The last is much longer than the fourth and bears a short tooth at each side near the base. This segment may be composed of two united. The three pairs of pleopods are nearly alike (pl. XIII, fig. 82), and consist of a basal segment bearing two semi-oval lamellæ, which, as well as the basal segment, are strongly ciliated. The uropods are scarcely longer than the last two segments of the pleon, and the basal segment is comparatively small; the second segment is nearly as long as the first, the third about half as long as the second and tipped with setæ, with which the first two segments are also provided.

Length 5.5 mm; breadth 1.1 mm; color brown, mottled with lighter above; beneath, nearly white.

This species occurred on piles and among algæ and eel-grass at Noank!, Conn., in the summer of 1874, along with *Leptochelia algicola*, but in much less abundance. It was described by Rathke from Molde, on the west coast of Norway, and inhabits also the British Isles, and while the present article was going through the press I received, through the kindness of Rev. T. R. R. Stebbing, specimens from Torquay!, England, which confirm my previous determination of our species as identical with the European form. It has been found by J. D. Macdonald "in the excavated wood of piers, in company with *Limnoria* and *Chelura terebrans*." It is doubtfully identified by Bate and Westwood with a Mediterranean species, *T. Cavolinii* Edw. On the authority of Lilljeborg I have regarded it as identical with *Tanais tomentosus* Kröyer, although differing in the number and proportion of the segments of the pleon, as described and figured by that author. Kröyer's specimens were from Øresund, Denmark.

Leptocheilia Dana.

Leptocheilia Dana, Am. Jour. Sci., II, vol. viii, p. 425, 1849; U. S. Expl. Exped., Crust., p. 800, 1853.

Paratanais Dana, Am. Jour. Sci., II, vol. xiv, p. 306, 1852; U. S. Expl. Exped., Crust., p. 798, 1853.

Antennulæ and antennæ simple; mandibles without palpi; pleon composed of six segments, bearing five pairs of ciliated pleopods below, and a pair of biramous uropods behind; incubatory pouch of the females of the normal form.

The genus *Leptocheilia* was constituted by Professor Dana for a form which Fritz Müller has since shown to be the male of *Paratanais* Dana, and although so far as I know the name has not hitherto been used for any but the male forms, I see no reason why it should not be adopted instead of the later name *Paratanais*. I have therefore adopted it for the four species lately described, from our coast. Dr. Stimpson's *Tanais filum* undoubtedly belongs to the same genus, making five species within our limits, only four of which I have seen. The species that I have examined may be further characterized as follows: The body is of nearly uniform size throughout. The antennulæ are directed forward and have a large basal segment, in contact with its fellow of the opposite side at its origin, and composing about half the length of the organ in the females; but in the males this segment, though absolutely much larger than in the females, may not form more than about a third of the total length of the antennula, which is nine to twelve jointed and terminated by a well developed flagellum. The antennæ differ but little in the sexes, and are five-jointed. The organs of the mouth are abortive in the males, and the oral region is covered below by a pair of subtriangular plates, perhaps the rudiments of the maxillipeds. The second thoracic segment is shorter than those that follow it; the fifth and sixth are the longest, and the seventh is shorter than the sixth.

The pleon consists of six distinct segments, subequal in length or with the last somewhat longer than the others. These segments are smooth above, and the first five bear on their under surface each a pair of pleopods, much like those of *Tanais* (pl. XIII, fig. 82), but not ciliated on the basal segment. The last segment bears a pair of uropods, which consist of a large basal segment bearing two terete rami. Of these the outer ramus is shorter and smaller than the inner, and may consist of a single segment so small and short as to be easily overlooked; the inner ramus is larger and longer, and composed, in our species, of from two to six segments. The number of these segments appears to be of value as a specific character, but not perfectly constant.

In the females the incubatory pouch is formed, as in the order generally, by four pairs of lamellæ attached to the bases of the second, third, fourth, and fifth pairs of legs.

Leptochelia algicola Harger.

Leptochelia Edwardsii Bate and Westwood, Brit. Sess. Crust., vol. ii, p. 134, 1868

* (*Tanais Edwardsii* Kröyer?).

Tanais filum Harger, This Report, part i, p. 573 [279], 1874 (*non* Stimpson).

Verrill, This Report, part i, p. 381 (87), 1874.

Paratanais algicola Harger, Am. Jour. Sci., III, vol. xv, p. 377, 1878.

Leptochelia algicola Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 162, 1879.

PLATES XII and XIII, FIGS. 80, 83-86.

The large and strong chelate claws, six-jointed pleon, and uropods with a short, one-jointed, outer ramus and a six-jointed inner ramus, will, in general, distinguish the present species from any other Isopod on our coast.

The body is of nearly uniform size throughout, and not constricted at the articulations. The head is narrowed in front. The eyes are conspicuous and plainly articulated, and are large in the males. The antennulæ in the females (pl. XIII, fig. 84*a*) are shorter than the head and first thoracic segment, and are composed of three segments, of which the first is longer than the second and third together, and the third is slightly longer than the second, and, in some specimens, present traces of a division into two segments. The basal segment bears a short, stout seta just beyond the middle and one or two more near the tip; the second has also setæ near the tip, and the third bears a tuft of half a dozen or more setæ at the tip. In the males (pl. XII, fig. 80) the antennulæ are about two-thirds as long as the body and usually eleven-jointed, but sometimes with one or two segments more or less than that number. The basal segment forms, in this sex, about one-third the length of the organ, and is curved from near the base so as to be convex upward; the next two segments decrease rapidly in length, and are followed usually by eight flagellar segments provided with "olfactory setæ" from two to four or more to a segment. The antennæ (pl. XIII, fig. 84*b*) in both sexes are short, slender, and decurved, terminated by a tuft of setæ. They appear to vary but little in the family.

The first pair of legs have the merus triangular, bringing the ischium and carpus together. In the female (pl. XIII, figs. 83 and 84*c*) these legs, in their natural position, extend but little beyond the head; the propodus has a stout, digital process nearly in the line of its axis; this process is broadly notched near the base, then elevated into a slightly serrulate lobe, and bears at the apex a short, stout terminal tooth. Near the base of the lobe are usually two stout setæ. The first pair of legs in the males are much larger and more elongated, especially in the last three segments; the carpus is elongate and cylindrical, extending about half its length beyond the head, and attaining the end of the basal antennular segment; the propodus (pl. XIII, fig. 85) is robust and has a strong, curved, and two-toothed digital process, bearing also two stout setæ near the second tooth; the dactylus is also curved and provided on its inner margin with

about seven short setæ springing from the bases of as many serratures; the propodus bears on its inner surface, above the origin of the dactylus, a comb, formed by a row of short setæ, and terminated at each end by a longer one. In the second pair of legs (pl. XIII, fig. 84 *d*) the dactylus, with its terminal spine, is not as long as the propodus, which bears two or three setæ near its tip. The third and fourth pairs of legs are shorter than the second. The last three pairs have their basal segments moderately swollen; the merus, carpus, and propodus of these legs are armed with a few spines near their distal ends; the dactyli are short.

The pleon is slightly broader near its base than the thoracic segments. The first five segments are subequal in length, the last longer and pointed behind. The uropods (pl. XIII, fig. 86) consist of a robust basal segment (*b*) bearing two rami, of which the outer (*o*) is very short and uniaarticulate; the inner (*i*) is six-jointed, tapering from the base, with the segments of about equal length and provided with setæ near their distal ends.

Length 2.2^{mm}; breadth 0.33^{mm}; color nearly white.

It is possible that this species may prove to be identical with *L. Edwardsii* (Krøyer) Dana, although differing from Krøyer's description* and figures, especially in the following particulars: The peduncle of the antennula, which, according to his description and figure, consists of a short basal segment, an elongated segment, and a third short segment, has by his description the ratio to the following flagellum of five to four. The basal segment that he describes and figures was probably only the enlarged basal portion of the elongated segment, which, together with the following segment, constitutes only about three-sevenths of the length of the organ instead of five-ninths according to his description. He further describes and figures the uropod as biramous, with the inner elongated ramus composed of seven segments instead of six. Other differences could be pointed out in the proportions of the thoracic segments and the segments of the first pair of legs. Bate and Westwood† figure and describe a species, which they regard as *L. Edwardsii*, although their description and figures differ somewhat from Krøyer's, principally in the fact that they figure and describe the uropods as simple, saying in the generic description: "Pleopoda, five anterior pairs biramose; posterior pair unibranched and multiarticulate;" and again under the species (p. 136), "The posterior or caudal pair of pleopoda consist of a single multiarticulate branch, of which the basal joint is larger than the terminal ones: it consists of nine or ten small articuli." They figure it on page 134 as simple, tapering from the base and seven-jointed. These authors express their indebtedness "for this interesting addition to our British fauna to the zeal and research of the Rev. A. M. Norman, who took it during the summer of

* Naturhist. Tidssk., vol. iv, p. 174, pl. ii, figs. 13-19.

† Brit. Sess. Crust., vol. ii, p. 134.

1865 among *Zostera* between tide marks in Belgrave Bay, Guernsey," and in the description of *Paratanais forcipatus*, on p. 139, mention in a foot-note a specimen from the same locality, "which has a pair of six-jointed anal filaments with a short one-jointed secondary filament arising from the extremity of the basal joint. Can this be the female of *Leptochelia Edwardsii* fully grown?"

Through the kindness of the Rev. Mr. Norman I have been able to examine a specimen labeled "*Leptochelia Edwardsii*, Guernsey, 1866," and do not find that it differs from our species in any characters that can be regarded as of specific value. The antennulæ have indeed only seven flagellar segments, or ten segments in all, which is also the case in some of our specimens, though eight such segments—eleven in all—is the usual number. The thoracic segments have the same proportion to each other as in our species, and the uropods agree exactly with ours in being biramous, with the outer ramus short and uniarticulate and the inner ramus six-jointed.

This is the form of uropod described and figured by Krøyer in *Tanaïs Savignyi*, which, as Fritz Müller has suggested, is probably the female of *T. Edwardsii* Kr. That species has, however, according to Krøyer, a five-jointed antennula, the last segment being rudimentary. I have observed among a large number of our specimens two which had the last segment divided, though scarcely longer than in the others. These specimens could hardly be distinguished from *T. Savignyi* Krøyer by any characters that I have observed. In view, however, of the great similarity of the females throughout the genus, as exemplified in the females of this species and of *L. rapax*, with both sexes of which I am familiar, I have concluded for the present to retain the specific name which I recently proposed for this species, and wait until an examination of both sexes can be had to decide the questions of specific identity.

I formerly regarded this species as identical with *Tanaïs filum* Stimpson, and supposed its range to extend to the Bay of Fundy. In view of the number of species now known to exist on this coast, and in the absence of any specimens from the Bay of Fundy, I now regard that as an error, and have corrected it in the American Journal of Science.

This species is rather abundant among eel-grass (*Zostera marina*) and algæ at Noank! and Wood's Holl!, and has been taken during the past summer (1879) at Provincetown!, Mass., among eel-grass, on a vessel's bottom and in old piles, in company with *Chelura terebrans* Philippi and *Limnoria lignorum* White. The specimen sent by the Rev. A. M. Norman enables me to extend its range to the Island of Guernsey!, in the British Channel.

Specimens examined.

Number.	Locality.	Fathoms.	Bottom.	When collected.	Received from—	Specimens.		Dry. Alc.
						No.	Sex.	
2126	Noank Harbor, Conn		Eel-grass	—, 1874	U. S. Fish. Com	00	♂ ♀	Alc.
2127	do		Eel-grass and algæ.	—, 1874	do	00	♂ ♀	Alc.
2128	do		do	—, 1874	do	10	♂	Alc.
2129	Vineyard Sound, Mass			—, 1871	do	1	♀	Alc.
2130	Vineyard Sound, Parker's Point		L. w. on algæ	—, 1875	do			Alc.
2131	do		On piles	—, 1875	do			Alc.
2132	do		Surface	—, 1875	do	3	♀	Alc.
2133	do			—, 1875	do	8		Alc.
	Provincetown, Masa.	Lw.		Aug. 22, 1879	do	18	♂ ♀	Alc.
	do		Eel-grass	Aug. 23, 1879	do	24	♂ ♀	Alc.
	do		do	Aug. 23, 1879	do	2	♀	Alc.
	do		In old piles	Aug. 23, 1879	do	1	♂	Alc.
	do		Vessel bottom	Sept. 3, 1879.	do	2	♂ ♀	Alc.

Leptochelia limicola Harger.

Paratanais limicola Harger, Am. Jour. Sci., III, vol. xv, p. 378, 1878.

Leptochelia limicola Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 163, 1879.

PLATE XIII, FIGS. 87, 88.

I have seen only females of this species, and these in general much resemble the same sex in *L. algicola* described above, but differ as follows: The eyes are small and inconspicuous, being less than half the transverse diameter of the basal antennular segment. The second segment of the antennulæ (pl. XIII, fig. 88 *a*) is short, only about half as long as the third. In the second pair of legs the dactylus with its terminal claw or spine is longer than the propodus, and the claw is slender and attenuated. The pleon is not wider than the segments of the thorax, and the uropods have the outer ramus two-jointed and surpassing the basal segment of the inner ramus, which is five-jointed, with the first segment long and imperfectly divided.

Length 2.5^{mm}. Color white in alcohol.

The specimens of this species were dredged in 48 fathoms, soft mud, in Massachusetts Bay!, off Salem, by the United States Fish Commission, in the summer of 1877.

Leptochelia rapax Harger.

Leptochelia rapax Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 163, 1879.

PLATE XIII, FIGS. 89, 90.

Females of this species closely resemble those of the two preceding species, but are distinguished by the following characters: The eyes are larger and more conspicuous than in *L. limicola*. The last segment of the antennulæ is scarcely longer than the preceding, instead of nearly twice as long. In the second pair of legs the dactylus is somewhat shorter, and the terminal spine less attenuated. The external ramus of the uropods consists of a single very short and small segment, shorter than the basal segment of the inner ramus, which is not elongated. The

inner ramus is five-jointed instead of six-jointed, as in *L. algicola*, from which species the males are easily distinguished by the elongate and slender antennulæ and chelate legs, and by other characters, as may be seen from the following description and the figures.

The males (pl. XIII, fig. 89) are remarkable for the long, slender hand terminating the first pair of legs (pl. XIII, fig. 90). The body of the male is short and robust, and the segments are well separated by constrictions at the sides. The head with the united first thoracic segment is short and rounded, bulging strongly at the sides just behind the eyes, which are conspicuous, considerably less in diameter than the bases of the antennulæ, distinctly articulated and coarsely faceted. The antennulæ are much elongated, especially in the basal segment, which constitutes nearly half the length of the organ, and is more than one-third as long as the body; this segment is straight, swollen on the inner side near the base, then tapers gradually to the tip; the second segment is a little over one-third the length of the first and cylindrical; the third is again about one-third the length of the second, and scarcely thicker than the following flagellar segments, which vary in number from six to eight, and are usually of about equal length. In case there are eight flagellar segments the first is, sometimes at least, considerably shorter than the others. The last segment is tipped with a rudiment, and bears a few setæ. The whole number of segments, therefore, varies from nine to eleven, and if one of the flagellar segments be taken as a unit of measurement, the length of the first three segments will be approximately expressed by the numbers 9, 3.8 and 1.4. The antennæ when extended do not far surpass the middle of the basal segment of the antennulæ, and are comparatively slender; the first segment is short and somewhat expanded distally; the second is slightly longer and expanded so as to be sub-cordate; the third is short and cylindrical, equal in length to the first; the fourth is the longest segment, being longer than the first three taken together, and is slender and cylindrical, with a few setæ near the tip; the fifth is more slender and but slightly shorter than the fourth, and is tipped with a minute rudimentary terminal segment and a few setæ.

The legs of the first pair are large and much elongated. They vary somewhat in size and proportions, but are commonly, when extended, longer than the body of the animal. In these legs the segments preceding the carpus are robust but comparatively short, while the carpus is about half as long as the body, and the propodus (pl. XIII, fig. 90) is even more elongated than the carpus, and is usually strongly flexed upon it. More than half the length of the propodus is made up of the slender digital process, which bears, near the base on the inner side, a low, obtuse tooth, and a larger and more prominent one near the slender incurved tip. The dactylus (pl. XIII, fig. 90) is more than half as long as the propodus, slender, curved, and pointed, and armed with scattered, weak spinules along the inner margin. The digital process of the pro-

podus bears also a few setæ, especially near the base of the outer tooth. The forceps thus formed are in most cases large enough to close around the body of another individual, but vary in size, being in some specimens at least one-third smaller than in others. The basal antennular segment may also be somewhat shorter than above described.

Of the thoracic segments the second (first free) segment is the shortest, and is also slightly broader than the others, and broader than the head. The third, fourth, and fifth segments increase in length progressively; the sixth is as long as the fifth; the seventh shorter. In the second pair of legs, the dactylus with its terminal claw is about as long as the propodus and nearly straight, as it is also in the third and fourth pairs, but the dactyli of the last three pairs of legs are more curved, and the basal segments somewhat swollen.

The first five segments of the pleon are of about equal length. The sixth is slightly shorter, obtusely pointed in the middle, and emarginate above the bases of the uropods, which are composed of a robust basal segment, bearing a minute outer ramus composed of a single segment tipped with setæ, and a five-jointed inner ramus, also sparingly provided with setæ. Between the uropods and below, a thin spatulate plate projects beyond the extremity of the pleon.

In length the males vary from 2.6^{mm} to 3.8^{mm}, and in breadth from 0.6^{mm} to 0.85^{mm}. The females measure in length about 2.3^{mm}; in breadth, 0.5^{mm}.

About one hundred specimens of this species, three-fourths of them females, were collected by Prof. A. Hyatt and Messrs. Van Vleck and Gardiner, in three feet of water, on muddy bottom, in the summer of 1878, at Annisquam!, Mass., and are the only specimens I have seen.

Leptochelia filum Harger (Stimpson).

Tanaïs filum, Stimpson, Mar. Inv. G. Manan, p. 43, 1853.

Packard, Mem. Bost. Soc. Nat. Hist., vol. i, p. 296, 1867.

Harger, Am. Jour. Sci., III, vol. xv, p. 378, 1878.

Leptochelia filum Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 164, 1879.

“Very minute, slender, rounded on the back, white, looking very much like a short piece of thread. Head small, and rather narrowed in front; first thoracic segment of great length; the second half as long as the third, which is about equal in length with the fourth, fifth, and sixth; the seventh being a little shorter than the sixth. The segments of the abdomen are well defined, the first five equaling each other in length, and the terminal one longer than the fifth, but narrower, and rounded behind. Antennæ short and thick, without flagellæ, with blunt tips crowned with few hairs, as are also their articulations. The inner ones are directed forward, and much the stoutest, especially toward their bases; while the outer ones are more slender and curve outward and backward. First pair of legs exceedingly thickened, with very large ovate hands and strong curved fingers. They are generally closely applied against

the breast. The remaining thoracic feet are very slender, terminating in sharp, slender fingers, which in the second pair are very long and nearly straight, and in the other pairs short. The legs of the posterior pair are a little the longest and thickest. The ambulatory feet, in five pairs, are of great length and resemble those of Amphipods. The caudal stylets are in length about four-fifths that of the abdomen, and consist of four or five articles, with few hairs, each article becoming narrower, the last one with a tuft of few hairs at its extremity. Length .15 inch; breadth .02. Dredged among *Ascidia callosæ*, in 20 fathoms, in the Hake Bay."

I have seen no specimens corresponding fully with the above description, which is copied from Dr. Stimpson; neither have I seen any specimens of this family from the Bay of Fundy. I formerly regarded the species from Vineyard Sound as *Tanais filum* Stimpson, and that name is used in this Report, part i, p. 573 (279), where also "Bay of Fundy to Vineyard Sound" is given as its range. This error was corrected by the writer in the American Journal of Science in 1878. In the absence of specimens from the Bay of Fundy I am unable to say positively that this species is not the same as my *P. limicola*, although the number of segments in the uropods does not correspond with those of that species, and the outer ramus of the uropods, which is rather conspicuous in that species, is not mentioned at all by Dr. Stimpson. Further investigation is needed to settle this question, but the number of species known to me from the coast seems sufficient warrant for regarding this, for the present at least, as a distinct species.

Dr. Packard states that he has dredged *Tanais filum* Stimpson in the Gulf of St. Lawrence, "at Caribou Island, in eight fathoms, on a sandy bottom."

Leptochelia cœca Harger.

Paratanais cœca Harger, Am. Jour. Sci., III, vol. xv, p. 378, 1878.

Leptochelia cœca Harger, Proc. U. S. Nat. Mus., 1879, vol. ii, p. 164, 1879.

PLATE XIII, FIG. 91.

This species is at once recognized among our Tanaisids by the absence of eyes. The enlarged chelate claws joined to the united head and first thoracic segment, and the six-jointed pleon serve to distinguish it as belonging to the present genus.

Body slender, elongated, and rather loosely articulated; head narrow in front, not broader than the bases of the antennulæ; eyes wanting; antennulæ distinctly four-jointed (pl. XIII, fig. 91a) in the type specimen, first segment forming less than half the length of the organ, second segment longer than the third, last segment about as long as the second, slender, tapering and tipped with setæ; antennæ attaining the tip of the third antennular segment. The first pair of legs (pl. XIII, fig. 91b) are robust, but less so than in the preceding species; they

extend forward in the natural position about to the tips of the antennæ; they have the basal segment subquadrate, the hand or propodus less robust than the carpus, with a serrated digital process; dactylus short.

The second, or first free, thoracic segment is about two-thirds as long as the third; this in turn is about equal to the fourth and to the fifth segments; while the sixth and seventh segments are progressively somewhat shorter. The second pair of legs are scarcely more slender than the following pairs, and the basal segments are not curved around the base of the first pair.

The uropods (pl. XIII, fig. 91c) are short, and biramous; each ramus two-jointed. The outer ramus is more slender than the inner, half its length, and bears a long bristle at the tip.

Length 2.5^{mm}; color white.

The first specimen of this species was dredged along with *L. limicola* in 48 fathoms, soft mud, Massachusetts Bay!, off Salem, in the summer of 1877, and a second specimen apparently of the same species, though differing somewhat in the antennulæ, was collected on the shore at Provincetown! during the summer of 1879. Unfortunately only a single specimen was obtained in each case, but it is very distinct from the other species of our coast. It does, however, closely approach *Tanais islandicus* G. O. Sars,* but appears to differ in the first pair of legs, which Sars describes as follows: "Pedes primi paris validi, manu sat dilatata, carpo vix angustiore, digitis palmæ longitudinem æquantibus vix forcipatis." These legs are in our species distinctly chelate, and the dactylus is much shorter than the propodus (see pl. XIII, fig. 91b). He further says: "Uropoda sat elongata, biramosa, ramis, ambobus biarticulatis, valde inæqualibus, exteriore ne 3^{tiam} quidem interioris longitudinis partem assequente." In our species the outer ramus of the uropod is about one-half as long as the inner.

GEOGRAPHICAL DISTRIBUTION.

The whole number of species enumerated is forty-six, three more than were included in my recent paper on New England Isopoda in the Proceedings of the United States National Museum. Their geographical distribution, especially on our coast, is summarized in the lists below.

The following eleven species have as yet been found only south of Cape Cod:

Scyphacella arenicola.
Actoniscus ellipticus.
Cepon distortus.
Bopyrus species.
Erichsonia filiformis.
Erichsonia attenuata.

Cirolana concharum.
Nerocila munda.
Ægathoa loliginea.
Livoneca ovalis.
Tanais vittatus.

*Archiv for Mathematik og Naturvidenskab, Bind ii, p. 346 [246], 1877.

The following nineteen have been found only north of Cape Cod:

Gyge Hippolytes.
Phryxus abdominalis.
Dajus mysidis.
Janira alta.
Janira spinosa.
Munna Fabricii.
Munnopsis typica.
Eurycope robusta.
Synidotea nodulosa.
Synidotea bicuspidata.

Astacilla granulata.
Cirolana polita.
Æga psora.
Syscenus infelix.
Gnathia cerina.
Leptochelia limicola.
Leptochelia rapax.
Leptochelia filum.
Leptochelia cœca.

The remaining sixteen are included in the following list as found on both sides of Cape Cod, but the letter N. is used to designate such species as are common north and rare south of the Cape, and S. signifies that the species is common at the south but rare northwards.

Philoscia vittata, S.
Jæra albifrons.
Hyarachna species.*
Chiridotea cœca.
Chiridotea Tuftsii, N.
Idotea irrorata.
Idotea phosphorea, N.
Idotea robusta.

Epelys trilobus, S.
Epelys montosus, N.
Sphæroma quadridentatum, S.
Limnoria lignorum.
Anthura polita, S.
Paranthura brachiata, N.
Ptilanthura tenuis.
Leptochelia algicola, S.

The eleven species included in the following list occur also on the coast of Europe. The British species are marked B.

Gyge Hippolytes, B.
Phryxus abdominalis, B.
Jæra albifrons, B.
Munna Fabricii.
Munnopsis typica.
Idotea irrorata, B.

Astacilla granulata.
Limnoria lignorum, B.
Æga psora, B.
Tanaïs vittatus, B.
Leptochelia algicola, B.

The number of Isopoda included in the present paper is considerably less than are known to inhabit Great Britain, being only about two-thirds as many as are included in Bate and Westwood's work, together with such additions to that fauna as have come to my knowledge since. As has been seen, eight, or nearly one-fifth of our marine species, are identical with those of Great Britain. The number of genera is much more nearly equal. Thirty-one marine genera are enumerated in the present paper, and of these sixteen are also British. The remaining fifteen do not appear to be represented on the British coast, but their place is filled by perhaps a rather greater number of genera. Of the families, neglecting the *Oniscidæ* as not properly included in the present paper, we come to the *Bopyridæ*, which have as yet been but little studied

* The only specimen yet known is from twenty-one miles east of Cape Cod.

on this coast. Five species only are enumerated here, two of which are also British, while Bate and Westwood enumerate twelve. A closer examination of the group may very likely add considerably to the present list.

The *Asellidæ* and *Munnopsidæ*, which Bate and Westwood would unite, have seven marine species belonging to six genera in our list, and, rejecting *Limnoria*, this number corresponds well with the British list of four genera and six species; one species, *Jæra albifrons* Leach, is identical, as are three of the genera—*Jæra*, *Janira*, and *Munna*. The more typical forms of the *Munnopsidæ* have not yet, as far as I am aware, been recognized in British waters.

The *Idoteidæ* are more numerous on our coast and appear to be more diversified than in Great Britain. I have regarded our eleven species as belonging to five different genera, while Bate and Westwood include the seven British species in a single genus. The most conservative could hardly class our species in less than three genera to one English genus, and, judging mostly from the figures and descriptions, I should be inclined to reckon three, or at least two, English genera to five on our coast in this family. One genus and species, *Idotea irrorata* Edw. (Say), is identical. Of the *Arcturidæ* a single representative has only recently been discovered within our limits, while three species, of the same genus as ours, are mentioned by Bate and Westwood, and Stebbing has since added two more species.

A single species of *Sphæroma* is the only representative on our coast of a family numbering no less than five genera and thirteen species in Bate and Westwood's volume. If the last two of these species be united as sexes of the same, and *Dynamene rubra* and *viridis* be also united, as suggested by Stebbing,* there are still left eleven representatives of this family in England to one on our coast. Our species is closely related to the British *Sphæroma serratum* Leach. *Limnoria lignorum* White is the only known representative of its family on both coasts.

The *Cirolanidæ* and *Ægidæ*, which are classed together under the latter name by most authors, have only four representatives in our limits, belonging to three genera. Two of these genera are also found in Great Britain, where they contain no less than seven species, one of which, *Æga psora* Krøyer, is identical on the two coasts. *Cirolana truncata* Norman is not included in Bate and Westwood, but these authors mention three other species belonging to as many genera in this group, making five genera and ten species from Great Britain to only three genera and four species in our waters. The *Cymothoidæ* are represented in our list by three species belonging to three genera, while Bate and Westwood say of this family, "No specimen has hitherto been satisfactorily determined as having been found in our own seas." The Rev. A. M. Norman, however, in the *Annals and Magazine of Natural History* for December, 1868, p. 422, mentions and briefly describes *Anilocra medi-*

* Jour. Linn. Soc., Zool., vol. xii, p. 148, 1874.

terranea Leach, taken from a "small fish in rock-pools at Herin in 1865." This genus has not been found on our coast.

Of the three genera and three species of *Anthuridæ* in our list two genera are also found in Great Britain, and it is possible that one species may yet prove identical. The *Gnathiidæ* are more difficult of comparison on account of the confusion that has existed in the sexes, and the larval forms. Our specimens seem to be all referable to a single species, doubtless congeneric with the British species, the number of which may, perhaps, by a liberal estimate, be placed at three.

In the *Tanaidæ*, the genera are the same as in Great Britain, and two of our species, *Tanais vittatus* Lillj. and *Leptochelia algicola* Harger, are found on both coasts. There remain a second species of *Tanais* on the British coast, and two species of *Leptochelia* (*Paratanais* of Bate and Westwood) against four species of *Leptochelia* on our coast, as the remaining representatives of this family. The genus *Apseudes* should probably be taken to represent a family not yet found on our coast.

We have, therefore, the following list of marine families, with the genera in each, that are identical on our coast and that of Great Britain. The species have been already indicated in a preceding list:

Bopyridæ: Gyge, Phryxus, Bopyrus. Two species.

Asellidæ: Jæra, Janira, Munna. One species.

Idoteidæ: Idotea. One species.

Arcturidæ: Astacilla.

Sphæromidæ: Sphæroma.

Limnoriidæ: Limnoria. One species.

Cirolanidæ: Cirolana.

Ægidæ: Æga. One species.

Cymothoidæ.

Anthuridæ: Anthura, Paranthura.

Gnathiidæ: Gnathia.

Tanaidæ: Tanais, Leptochelia. Two species.

Further details of geographical and also of bathymetrical distribution are presented in the table on pages 139 to 141, in which the first column shows the least depth in fathoms at which each species has been collected on our coast; the second the greatest depth; and the following eighteen columns are for different localities, which may be further explained as follows: The Carolinas include Charleston, S. C., Fort Macon, N. C., and Norfolk, Va.; New Jersey includes Great Egg Harbor and Atlantic City, N. J., and Fire Island Beach, on the south shore of Long Island; Long Island Sound includes Savin Rock, New Haven, Stony Creek, or Thimble Islands, Saybrook, New London, and Norwalk, Conn.; Block Island includes Watch Hill, Block Island Sound, and the deeper water off the island; Vineyard Sound includes also Buzzard's Bay, Nantucket Sound, and off Nantucket Island; Cape Cod Bay includes Provincetown and Barnstable; Massachusetts Bay includes Salem, Nahant, Glou-

cester, and Annisquam, Mass.; the Gulf of Maine includes all outside of the line of 50 fathoms between Cape Cod and Nova Scotia, and extending seaward to include George's Banks; Casco Bay includes Cape Elizabeth and Quahog Bay; Bay of Fundy includes Eastport Harbor and Grand Menan, while species collected at greater depths than 50 fathoms are reckoned also in the Gulf of Maine, and the same is true of those from that depth off Nova Scotia; Nova Scotia includes also Banquereau or Quereau, Eastern and Western Banks, Miquelon Island, and the Grand Banks. Species occurring on the north shore of the Gulf of St. Lawrence are credited also to Labrador. In the last column of the table the general habitat of each species is briefly indicated.

ORDINARY HABITAT.

ONISCIDÆ:

Philoscia vittata
Scyphocella arenicola
Aetideus ellipticus

BOYRIIDÆ:

Cepon distortus
Gyge Hippolytes
Phryxus abdominalis
Dagius mysidis
Bopyrus, species

ASELLIDÆ:

Jaera albifrons
Janira alta
spinos
Munna Fabricii

MUNNOPSISIDÆ:

Munnopsis typica
Eurycope robusta
Ilyarachna, species

IDOTEIDÆ:

Chiridotea caeca
Tuftsii
Idotea irrorata
phosphorea
robusta
Synidotea nodulosa
bicuspidata

Shore, under rubbish.
 Shore, in sand.
 Shore, under rubbish.

Parasitic on *Gelasimus*.
 Parasitic on *Hippolyte*, &c.
 Parasitic on *Pandalus*, *Hippolyte*, &c.
 Parasitic on *Mysis*.
 Parasitic on *Palemonetes*.

Under seaweed, in tide-pools, &c.
 Muddy, stony, or shelly bottoms.
 Eel-grass, coralline, shells, &c.

Muddy bottoms.
 Do.
 Do.

In sand at low water.
 Sandy bottoms.
 Algae and eel-grass.
 Open ocean at the surface.
 Rocky, stony, and sandy bottoms.

LIST OF AUTHORITIES.

The present list includes only such works and articles, relating wholly or in part to Crustacea, as have been quoted, or otherwise used, in the preparation of the preceding paper, and is chiefly intended to aid in consultation of the authorities quoted. A few of the titles are necessarily given at second hand, as indicated by quotation marks in the list. The references to these works occurring throughout the article are also inclosed in quotation marks, usually with an accompanying mention of the author from whom they are taken. In all other cases the references have been made directly from the works quoted. A considerable number of authorities have not been referred to, and are omitted from the list, because at present inaccessible, and, for many of the most important works that I have been able to consult, I am indebted to the liberality of Professor S. I. Smith, who has given me the free use of his library and afforded other material aid in the preparation of the article. I have also had free access to the libraries of Professors Verrill, Marsh and Dana.

In this list, as throughout the article, the number of the series of various scientific publications is indicated by Roman numerals in capitals. As far as possible references have been made to the original paging, sometimes with that of the separata added in a parenthesis, and, in the following list, a parenthesis is used to denote that the paging is, or is supposed to be, that of the separata.

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- (All the figures were drawn from nature by O. Harger.)

PLATE II.

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(Figures 9 and 10 were drawn from nature by O. Harger; figure 11 is copied from M. Sars, drawn by G. O. Sars.)

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diameters; *f*, one of the sixth pair of legs; *g*, uropod, each enlarged twenty diameters.

(Figure 14 was drawn from nature by Mr. J. H. Emerton, the others by O. Harger.)

PLATE IV.

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17.—The same; *a*, antennula; *b*, antenna; each enlarged twelve diameters.

18.—The same; *a*, maxilliped from the right side, external view; *l*, external lamella; *m*, maxilliped proper; 1, 2, 3, first, second, and third segments of the palpus of the maxilliped, enlarged twenty diameters; *b*, one of the first pair of legs, magnified twelve diameters; *c*, uropod from the left side, inner view, showing the two rami articulated near the tip.

19.—The same; pleopods of second pair from the right side, anterior views, enlarged ten diameters; *a*, common form in males; *b*, rarer form in male; *s*, elongated stylet, articulated near the base of the inner lamella; *c*, form in the female.

20.—*Chiridotea Tuftsii* Harger (p. 340); female; dorsal view, enlarged five diameters; natural size indicated by the line at the right.

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22.—The same; pleopod of the second pair, from a male, enlarged twenty diameters; *s*, elongated stylet, articulated near the base of the inner lamella.

(All the figures were drawn from nature by O. Harger.)

PLATE V.

FIGURE 23.—*Chiridotea Tuftsii* Harger (p. 340); *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, leg of the fourth pair; all enlarged twelve diameters; *e*, left uropod, or opercular valve, inner view, enlarged ten diameters.

24.—*Idotea irrorata* Edwards (p. 343); dorsal view, enlarged two diameters; natural size shown by the line on the left.

25.—The same; *a*, antennula; *b*, antenna; *c*, left uropod or opercular valve, external view; all enlarged six diameters.

26.—The same; *a*, right maxilliped, enlarged twelve diameters, *l*, external lamella; *m*, basal segment; 1, 2, 3, 4, segments of palpus of maxilliped; *b*, pleopod of the second pair from a male, enlarged eight diameters, showing stylet, *s*, articulated near the base of the inner lamella.

27.—*Idotea phosphorea* Harger (p. 347); dorsal view, enlarged about two diameters; natural size shown by the line on the right.

28.—The same; *a*, antenna, enlarged six diameters; *b*, maxilliped, enlarged twelve diameters, showing, *l*, external lamella; *m*, basal segments; 1, 2, 3, 4, segments of the palpus of maxilliped; *c*, leg of the first pair; *d*, leg of the second pair, both enlarged six diameters; *e*, right uropod, or opercular valve, inner view, enlarged six diameters.

29.—The same; pleopod of the second pair from a male, enlarged eight diameters; *s*, stylet articulated near the base of the inner lamella; *s'*, distal end of stylet reversed and enlarged thirty diameters.

(Figure 24 was drawn by Mr. J. H. Emerton, the others by O. Harger.)

PLATE VI.

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- FIGURE 32.**—The same; *a*, maxilliped, enlarged twelve diameters; *l*, external lamella; 1, 2, 3, 4, segments of palpus; *b*, maxilla of the outer or second pair; *c*, pleopod of the second pair from a male, enlarged six diameters; *s*, stylet articulated near the base of the inner lamella.
- 33.—*Synidotea nodulosa* Harger (p. 351); dorsal view, enlarged four diameters; natural size indicated by the line at the right.
- 34.—The same; *a*, antennula; *f*, flagellar segment; *b*, antenna; *c*, leg of the first pair from the right side; *d*, right uropod, or opercular valve, all enlarged ten diameters.
- 35.—The same; *a*, maxilliped from the right side, showing, *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus, enlarged twenty diameters; *b*, maxilla of the outer or second pair; *c*, maxilla of the inner or first pair, both enlarged twenty diameters; *d*, pleopod of the second pair from a male, enlarged twelve diameters; *s*, stylet articulated near the base of the inner lamella.
- 36.—*Erichsonia attenuata* Harger (p. 356); dorsal view, enlarged three diameters, natural size indicated by the line at the right.
- (Figures 30 and 36 were drawn by Mr. J. H. Emerton, the others by O. Harger.)

PLATE VII.

- FIGURE 37.**—*Erichsonia attenuata* Harger (p. 356); *a*, antennula; *b*, antenna, each enlarged twelve diameters; *c*, maxilliped, showing, *l*, external lamella, enlarged thirty diameters; *d*, uropod, or opercular valve, enlarged twelve diameters; *e*, pleopod of the second pair from a male, enlarged fifteen diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged fifty diameters.
- 38.—*Erichsonia filiformis* Harger (p. 355); dorsal view, enlarged five diameters, natural size indicated by the line at the right.
- 39.—The same; *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, uropod, or opercular valve, each enlarged twelve diameters.
- 40.—The same; *a*, maxilla of outer or second pair; *b*, maxilla of inner or first pair; *c*, mandible, showing molar process, *m*, and dentigerous lamella, *d*, all enlarged thirty diameters.
- 41.—The same; *a*, maxilliped, showing, *l*, external lamella; *m*, basal segment, and 1, 2, 3, 4, segments of palpus, enlarged thirty diameters; *b*, pleopod of the second pair from a male, enlarged fifteen diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged fifty diameters.
- 42.—*Epelys trilobus* Smith (p. 358); dorsal view, enlarged ten diameters; natural size indicated by the line at the right.
- 43.—The same; *a*, maxilliped from the left side, enlarged twenty diameters; *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus of maxilliped; *b*, pleopod of second pair from a male, enlarged twenty diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, end of stylet, enlarged fifty diameters.

(All the figures were drawn from nature by O. Harger.)

PLATE VIII.

- FIGURE 44.**—*Epelys montosus* Harger (p. 359); dorsal view, enlarged six diameters, natural size indicated by the line at the right.
- 45.—The same; *a*, antennula; *f*, flagellar segment; *b*, antenna; *c*, maxilliped from the left side; *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus; all the figures enlarged twenty diameters.
- 46.—The same; *a*, leg of the first pair, enlarged twenty diameters; *b*, right uropod or opercular valve, enlarged fifteen diameters.

FIGURE 47.—The same; pleopod of the second pair, from a male, enlarged twenty diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged sixty-six diameters.

48.—*Astacilla granulata* Harger (p. 364); female; dorsal view, enlarged four diameters, natural size indicated by the line at the right; *a*, antennula of male; *b*, fourth thoracic segment of male; *c*, inferior surface of pleon of a male, showing opercular valves; all the figures enlarged four diameters.

49.—The same; *a*, flagellum of antenna, enlarged twenty diameters; *a'*, portion of inner margin of the same, enlarged one hundred diameters; *b*, one of the first pair of legs, upper surface, enlarged twenty diameters.

50.—The same; one of the fourth pair of legs, enlarged twenty diameters.

51.—The same; inner surface of left opercular plate, or uropod, from a female, enlarged twenty diameters.

(All the figures were drawn from nature by O. Harger.)

PLATE IX.

FIGURE 52.—*Astacilla granulata* Harger (p. 364); *a*, maxilliped; *m*, basal segment; *l*, external lamella; *b*, outer maxilla; *c*, inner maxilla; all enlarged twenty diameters.

53.—*Spharoma quadridentatum* Say (p. 368); dorsal view, enlarged five diameters; natural size indicated by the line at the right.

54.—The same; *a*, antennula; *b*, antenna; *c*, pleopod of the second pair, from a male, showing stylet, *s*, articulated near the base of the inner lamella; all the figures enlarged ten diameters.

55.—*Limnoria lignorum* White (p. 373); dorsal view, enlarged ten diameters; natural size indicated by the line at the right.

56.—The same; *a*, antennula; *b*, antenna; *c*, maxilliped; *d*, maxilla of the outer or second pair; *e*, maxilla of the inner or first pair; *f*, mandible, all enlarged twenty-five diameters; *e'*, distal end of outer lobe of first pair of maxillæ, enlarged sixty-six diameters.

57.—The same; *a*, last segment of pleon, with attached uropods; dorsal view, enlarged ten diameters; *b*, uropod with dotted adjacent outline of last segment of pleon, enlarged thirty diameters; *c*, first pair of pleopods; *d*, pleopod of the second pair, from a male, showing stylet, *s*, articulated to the inner lamella; both figures enlarged twenty diameters.

58.—*Cirolana concharum* Harger, (p. 378); lateral view, enlarged about three diameters.

(Figure 53 was drawn by Mr. J. H. Emerton, 55 by Prof. S. I. Smith, 58 by Mr. J. H. Blake, and the others by O. Harger.)

PLATE X.

FIGURE 59.—*Cirolana concharum* Harger (p. 378); dorsal view, enlarged about three diameters. The natural size is shown by the line at the right.

60.—The same; antennula, enlarged ten diameters.

61.—The same; *a*, antenna enlarged ten diameters; *b*, maxilla of the outer or second pair; *c*, maxilla of the inner or first pair; *d*, mandible from the right side, inner view; *p*, palpus; *m*, molar area; the last three figures enlarged five diameters.

62.—The same; *a*, maxilliped from the right side, exterior view, showing, *l*, external lamella; *m*, basal segment; 1, 2, 3, 4, 5, segments of the palpus; *b*, leg of the fourth pair; both the figures enlarged five diameters.

63.—The same; uropod from the right side; inferior view, enlarged five diameters.

64.—*Æga psora* Krøyer (p. 384); *a*, dorsal and *b* ventral views of a young individual. The central line indicates the length of the specimen, natural

size, which is here enlarged three diameters. Adults attain about the size of the figure.

FIGURE 65.—*Nerocila munda* Harger (p. 392); dorsal view of the type specimen, enlarged about four diameters. The natural size is shown by the cross on the right; *a*, uropod, enlarged six diameters.

66.—*Ægathoa loliginea* Harger (p. 393); type specimen; *a*, dorsal, and *b*, ventral view, enlarged four diameters. Its natural size is shown by the line between the figures.

(Figure 59 was drawn by Mr. J. H. Blake, the others by O. Harger.)

PLATE XI.

FIGURE 67.—*Livoneca ovalis* White (p. 395); *a*, antennula; *b*, antenna; *c*, mandibular palpus; each enlarged twenty diameters; *d*, one of the first pair of legs; *e*, one of the seventh pair of legs; *f*, uropod; each enlarged ten diameters.

68.—*Anthura polita* Stimpson (p. 398); dorsal view, enlarged four diameters. The natural size is shown by the line at the right; *a*, antennula; *b*, antenna, each enlarged ten diameters; *c*, leg of the first pair; *d*, leg of the third pair; *e*, right pleopod of the first pair, interior view, showing inner ramus without cilia; *f*, pleopod of the second pair from a male, showing stylet articulated to inner lamella; each of the figures *e* to *f* enlarged eight diameters; *g*, lateral view of pleon, enlarged six diameters.

69.—The same; *a*, maxilliped, enlarged twenty diameters; *b*, maxilla, enlarged twenty-five diameters; *b'*, distal end of the same, enlarged sixty diameters.

70.—*Paranthura brachiata* Harger (p. 402); dorsal view, enlarged about three diameters; natural size shown by the line at the right; *a*, antennula; *b*, antenna, enlarged eight diameters; *c*, right maxilliped, enlarged sixteen diameters; *d*, maxilla, enlarged sixteen diameters; *d'*, distal end of the same, enlarged fifty diameters; *e*, leg of the first pair; *f*, first pleopod from the right side, inner view, showing ciliated inner lamella; *g*, pleopod of the second pair from a male, showing stylet articulated to the inner lamella; figures *e* to *g* enlarged eight diameters.

71.—*Ptilanthura tenuis* Harger (p. 406); male; dorsal view, enlarged about four diameters; *a*, inferior view of the head and first thoracic segment, enlarged eight diameters; the flagellum of the antennulæ omitted; *b*, maxilliped; *c*, maxilla, each enlarged fifty diameters; *d*, first right pleopod, seen from within, showing ciliated inner lamella; *e*, second left pleopod, showing stylet articulated to the inner lamella in the males.

72.—The same; one of the first pair of legs of a male, enlarged sixteen diameters.

73.—The same; female; dorsal view of the head, enlarged twenty-five diameters.

(Figure 71, excepting *b-d*, was drawn by Mr. J. H. Emerton, the others by O. Harger.)

PLATE XII.

FIGURE 74.—*Ptilanthura tenuis* Harger (p. 406); *a*, antennula; *b*, antenna; each enlarged twenty diameters, from a male.

75.—*Gnathia cerina* Harger (p. 410); male; dorsal view, enlarged ten diameters.

76.—The same; *a*, antennula; *b*, antenna, each enlarged thirty-eight diameters; *c*, mandibles (*l*, left, *r*, right), enlarged thirty-eight diameters; *d*, first leg or first gnathopod from the right side, enlarged twenty-five diameters; all the figures from the male sex.

77.—The same (p. 411); female; dorsal view, enlarged ten diameters.

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79.—The same; young male; dorsal view, enlarged twenty diameters.

80.—*Leptochelia algicola* Harger (p. 421); male; lateral view, enlarged twenty diameters; natural size indicated by the line above.

(All the figures were drawn from nature by O. Harger.)

PLATE XIII.

FIGURE 81.—*Tanais vittatus* Lilljeborg (p. 418); dorsal view, enlarged eight diameters. The transverse bands of hairs on the pleon are not sufficiently distinct.

82.—The same; one of the first pair of pleopods, enlarged thirty diameters.

83.—*Leptochelia algicola* Harger (p. 421); female; dorsal view, enlarged twenty diameters; natural size indicated by the line at the right.

84.—The same; *a*, antennula; *b*, one of the first pair of legs; both from a female specimen and enlarged twenty-five diameters.

85.—The same; hand, or propodus and dactylus of the first pair of legs, enlarged forty-eight diameters, showing the comb of setæ on the propodus.

86.—The same; uropods of a male, enlarged seventy diameters; *b*, basal segment; *i*, inner six-jointed ramus; *o*, outer ramus.

87.—*Leptochelia limicola* Harger (p. 424); female; dorsal view, enlarged twenty diameters; natural size shown by the line at the right.

88.—The same; *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, leg of the second pair; all from the female sex and enlarged twenty-five diameters.

89.—*Leptochelia rapax* Harger (p. 424); male; dorsal view, enlarged about twelve diameters.

90.—The same; hand, or propodus and dactylus of male, enlarged sixteen diameters.

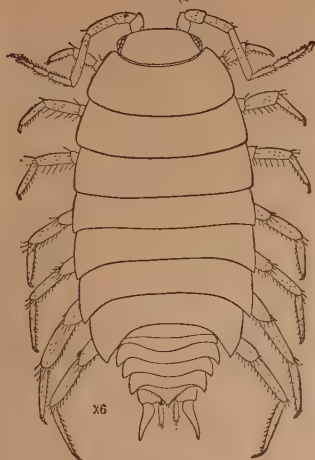
91.—*Leptochelia coeca* Harger (p. 427); type specimen, female; *a*, antennula; *b*, leg of the first pair; *c*, uropod; each enlarged fifty diameters.

(All the figures were drawn from nature by O. Harger.)

PLATE I.

- FIGURE 1.—*Philoscia vittata* Say (p. 306); dorsal view, enlarged six diameters; natural size indicated by cross at the right.
- 2.—*Scyphacella arenicola* Smith (p. 307); dorsal view, enlarged about twelve diameters; natural size indicated by cross at the right.
- 3.—*Actoniscus ellipticus* Harger (p. 309); dorsal view, enlarged ten diameters; natural size indicated by line at the right.
- 4.—*Jæra albifrons* Leach (p. 315); female; dorsal view, enlarged about ten diameters.
- 5.—The same; maxilliped from the left side, exterior view, enlarged twenty-five diameters; *P*, palpus; *l*, external lamella.
- 6.—The same; maxillæ, enlarged twenty-five diameters; *a*, outer, or second, pair of maxillæ; *b*, inner, or first, pair of maxillæ; *i*, inner, *e*, outer lobe.
- 7.—The same; inferior surface of the pleon of a female.
- 8.—The same; inferior surface of the pleon of a male.
- (All the figures were drawn from nature by O. Harger.)

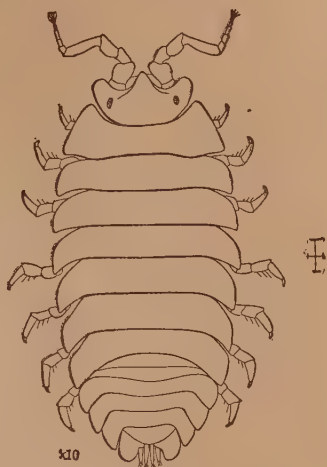
Fig. 1.



x6

No. 923.

Fig. 3.



x10

No. 929.

Fig. 5.



x25

No. 921.

Fig. 6.

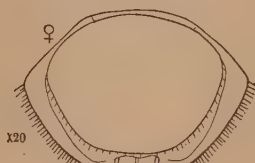


x25

x25

No. 923.

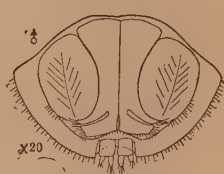
Fig. 7.



x20

No. 945.

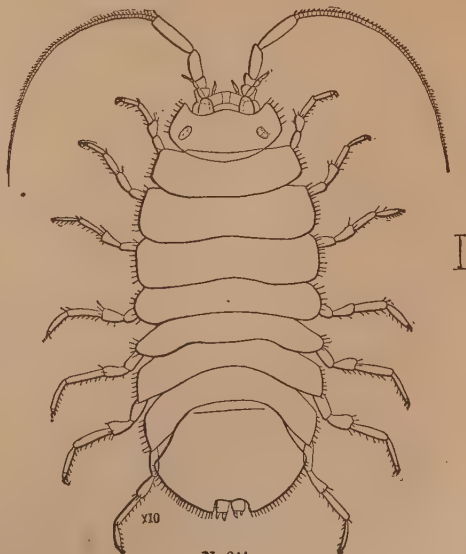
Fig. 8.



x20

No. 916.

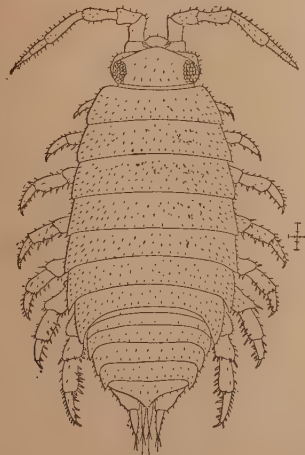
Fig. 4.



x10

No. 914.

Fig. 2.



No. 934.





PLATE II.

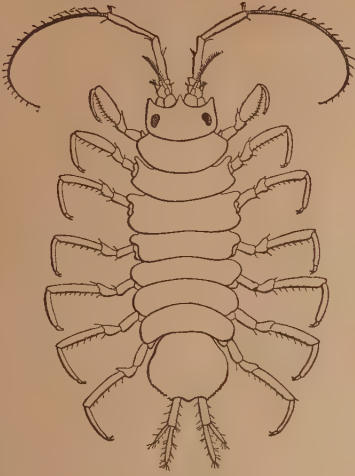
FIGURE 9.—*Janira alta* Harger (p. 321); dorsal view, enlarged five diameters; natural size indicated by line at the right.

10.—*Janira spinosa* Harger (p. 323); dorsal view of female, enlarged six diameters.

11.—*Munnopsis typica* M. Sars (p. 330); dorsal view of male, enlarged about two diameters; *b*, maxillipeds; *m*, basal segment; *l*, external lamella; 2 and 3, second and third segments of palpus of maxillipeds; *c*, outer maxillæ; *d*, inner maxillæ; *e*, one of the second pair of legs of the male; *f*, one of the natatory legs; *g*, abdominal operculum of the female, external view.

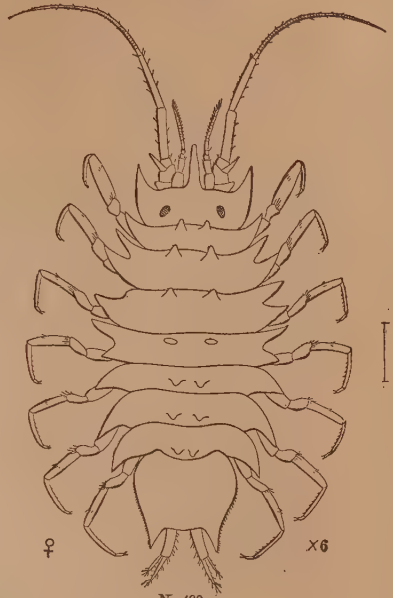
(Figures 9 and 10 were drawn from nature by O. Harger; figure 11 is copied from M. Sars, drawn by G. O. Sars.)

Fig 9.



No. 924.

Fig. 10.

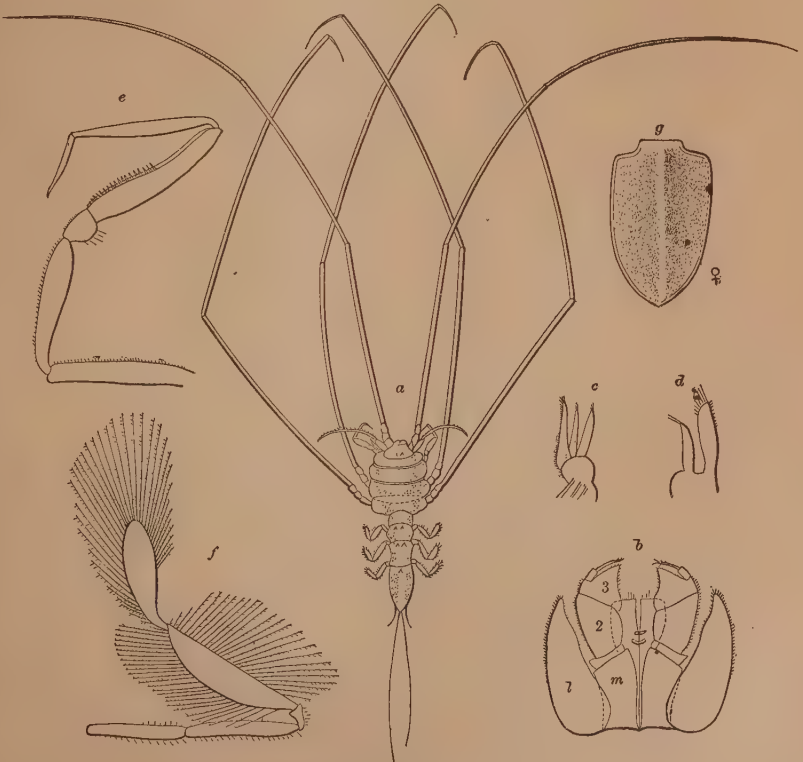


♀

X6

No. 499.

Fig. 11.



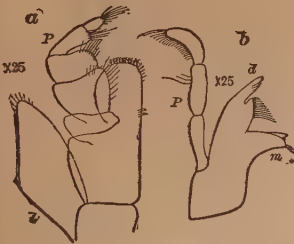
No, 490

PLATE III.

- FIGURE 12.**—*Janira alta* (p. 321); *a*, maxilliped; *P*, palpus of maxilliped; *l*, external lamella; *b*, mandible; *P*, palpus of mandible; *d*, dentigerous lamella; *m*, molar process, enlarged twenty-five diameters.
- 13.—The same; inferior surface of the pleon, *a* in the female, *b* in the male, enlarged ten diameters; *a*, single opercular plate in the female; *b*, external; *c*, median plate of operculum of male.
- 14.—*Munna Fabricii* Kröyer (p. 325); female; dorsal view, enlarged about twenty diameters; natural size indicated by line at the right.
- 15.—*Eurycope robusta* Harger (p. 332); female; dorsal view, enlarged six diameters; natural size indicated by line at the right; *a*, antennula, enlarged twenty diameters; *b*, maxilliped; *c*, mandible; *d*, one of the first pair of legs, each enlarged twenty diameters; *d'*, propodus and dactylus of the first pair of legs, enlarged about thirty-eight diameters; *e*, propodus and dactylus of the second pair of legs, enlarged twenty diameters; *f*, one of the sixth pair of legs; *g*, uropod, each enlarged twenty diameters.

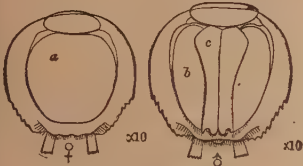
(Figure 14 was drawn from nature by Mr. J. H. Emerton, the others by O. Harger.)

Fig. 12.



No. 922.

Fig. 13.



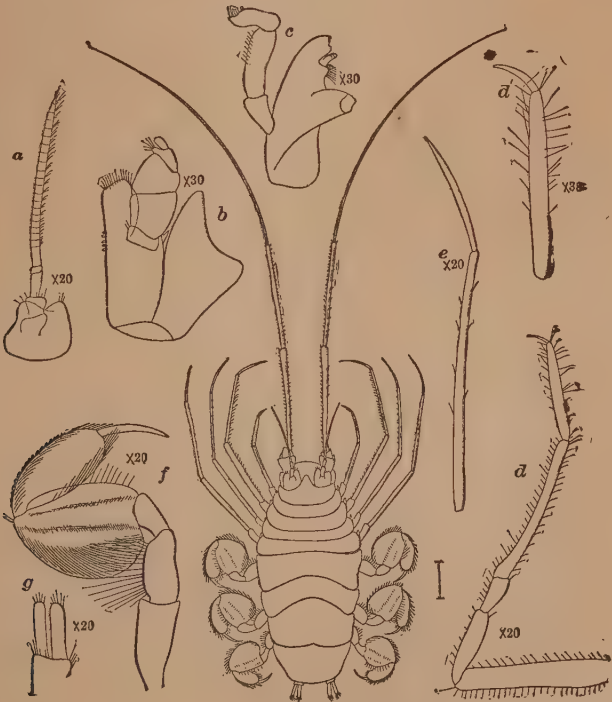
No. 925.

Fig. 14.



No. 914.

Fig. 15.



No. 918.



REPORT

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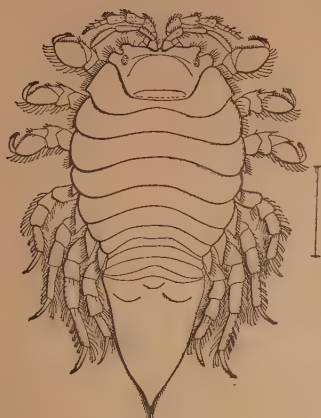
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PLATE IV.

- FIGURE 16.**—*Chiridotea cœca* Harger (p. 338); dorsal view, enlarged nearly four diameters; natural size indicated by the line at the right.
- 17.**—The same; *a*, antennula; *b*, antenna; each enlarged twelve diameters.
- 18.**—The same; *a*, maxilliped from the right side, external view; *l*, external lamella; *m*, maxilliped proper; 1, 2, 3, first, second, and third segments of the palpus of the maxilliped, enlarged twenty diameters; *b*, one of the first pair of legs, magnified twelve diameters; *c*, uropod from the left side, inner view, showing the two rami articulated near the tip.
- 19.**—The same; pleopods of second pair from the right side, anterior views, enlarged ten diameters; *a*, common form in males; *b*, rarer form in male; *s*, elongated stylet, articulated near the base of the inner lamella; *c*, form in the female.
- 20.**—*Chiridotea Tuftsii* Harger (p. 340); female; dorsal view, enlarged five diameters; natural size indicated by the line at the right.
- 21.**—The same; left maxilliped, enlarged twenty-five diameters; *e*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus.
- 22.**—The same; pleopod of the second pair, from a male, enlarged twenty diameters; *s*, elongated stylet, articulated near the base of the inner lamella.

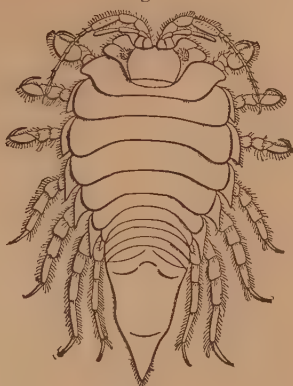
(All the figures were drawn from nature by O. Harger.)

Fig. 16.



No. 782

Fig. 20.



No. 956.

Fig. 19.

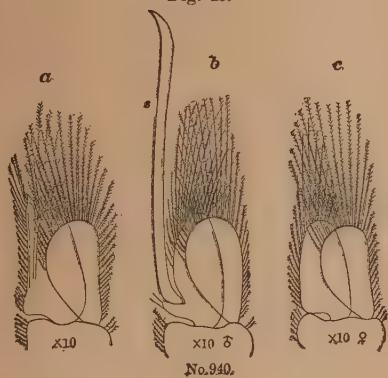


Fig. 22.

Fig. 21.

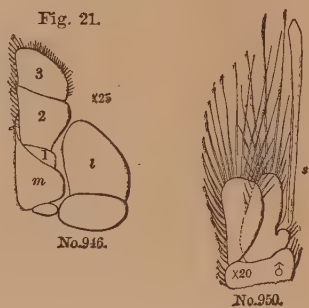


Fig. 18.

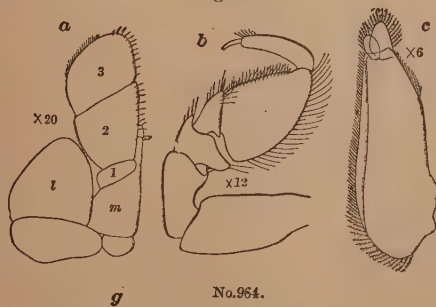


Fig. 17.

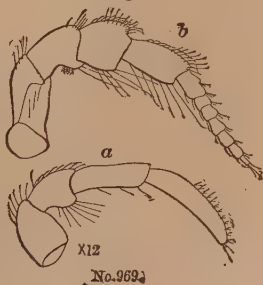


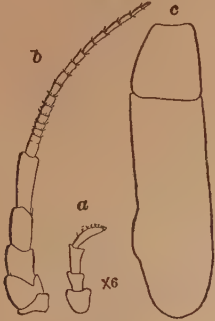


PLATE V.

- FIGURE 23.**—*Chiridotea Tuftsii* Harger (p. 340); *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, leg of the fourth pair; all enlarged twelve diameters; *e*, left uropod, or opercular valve, inner view, enlarged ten diameters.
- 24.**—*Idotea irrorata* Edwards (p. 343); dorsal view, enlarged two diameters; natural size shown by the line on the left.
- 25.**—The same; *a*, antennula; *b*, antenna; *c*, left uropod or opercular valve, external view; all enlarged six diameters.
- 26.**—The same; *a*, right maxilliped, enlarged twelve diameters, *l*, external lamella; *m*, basal segment; 1, 2, 3, 4, segments of palpus of maxilliped; *b*, pleopod of the second pair from a male, enlarged eight diameters, showing stylet, *s*, articulated near the base of the inner lamella.
- 27.**—*Idotea phosphorea* Harger (p. 347); dorsal view, enlarged about two diameters; natural size shown by the line on the right.
- 28.**—The same; *a*, antenna, enlarged six diameters; *b*, maxilliped, enlarged twelve diameters, showing, *l*, external lamella; *m*, basal segments; 1, 2, 3, 4, segments of the palpus of maxilliped; *c*, leg of the first pair; *d*, leg of the second pair, both enlarged six diameters; *e*, right uropod, or opercular valve, inner view, enlarged six diameters.
- 29.**—The same; pleopod of the second pair from a male, enlarged eight diameters; *s*, stylet articulated near the base of the inner lamella; *s'*, distal end of stylet reversed and enlarged thirty diameters.

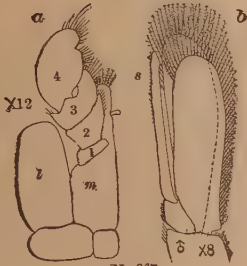
(Figure 24 was drawn by Mr. J. H. Emerton, the others by O. Harger.)

Fig. 25.



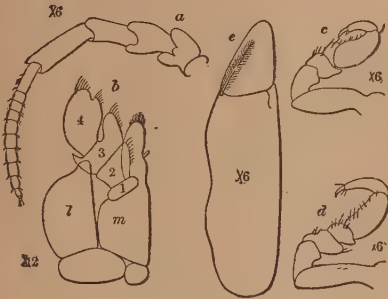
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Fig. 26.



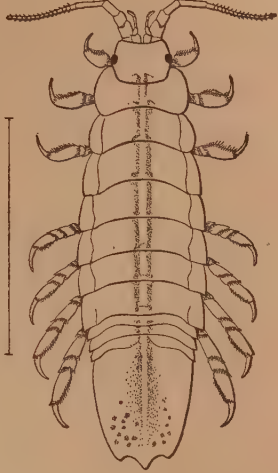
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Fig. 28.



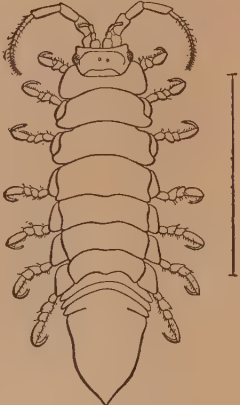
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Fig. 24.



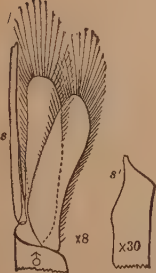
533

Fig. 27.



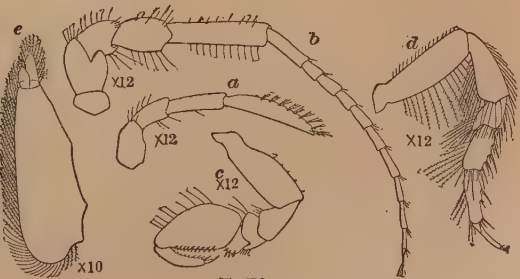
No. 955.

Fig. 29.



No. 949.

Fig. 23.

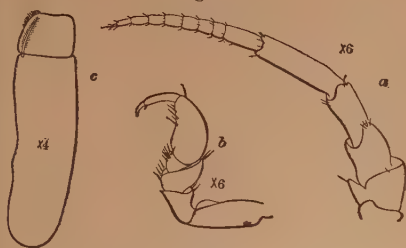


No. 970.

PLATE VI.

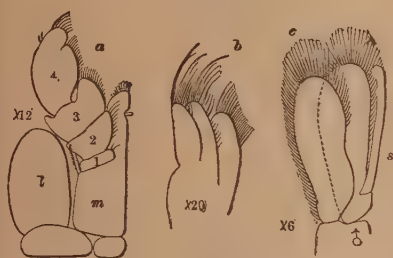
- FIGURE 30.—*Idotea robusta* Kröyer (p. 349); dorsal view, enlarged two diameters; natural size shown by the line at the right.
- 31.—The same; *a*, antenna; *b*, leg of the first pair, each enlarged six diameters; *c*, left uropod, or opercular valve, inner view, enlarged four diameters.
- FIGURE 32.—The same; *a*, maxilliped, enlarged twelve diameters; *l*, external lamella; 1, 2, 3, 4, segments of palpus; *b*, maxilla of the outer or second pair; *c*, pleopod of the second pair from a male, enlarged six diameters; *s*, stylet articulated near the base of the inner lamella.
- 33.—*Synidotea nodulosa* Harger (p. 351); dorsal view, enlarged four diameters; natural size indicated by the line at the right.
- 34.—The same; *a*, antennula; *f*, flagellar segment; *b*, antenna; *c*, leg of the first pair from the right side; *d*, right uropod, or opercular valve, all enlarged ten diameters.
- 35.—The same; *a*, maxilliped from the right side, showing, *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus, enlarged twenty diameters; *b*, maxilla of the outer or second pair; *c*, maxilla of the inner or first pair, both enlarged twenty diameters; *d*, pleopod of the second pair from a male, enlarged twelve diameters; *s*, stylet articulated near the base of the inner lamella.
- 36.—*Erichsonia attenuata* Harger (p. 356); dorsal view, enlarged three diameters, natural size indicated by the line at the right.
- (Figures 30 and 36 were drawn by Mr. J. H. Emerton, the others by O. Harger.)

Fig. 31.



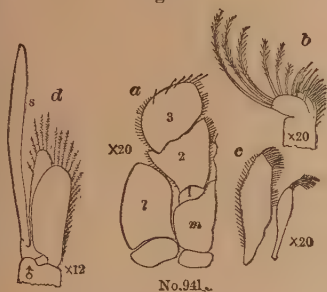
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Fig. 32.



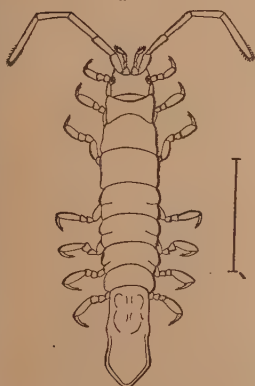
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Fig. 35.



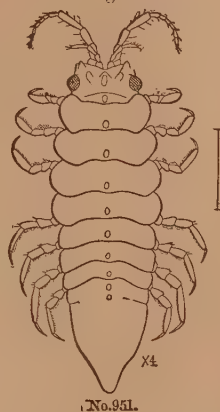
No. 941.

Fig. 36.



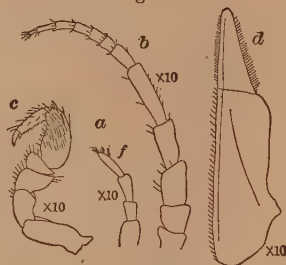
No. 535

Fig. 33.



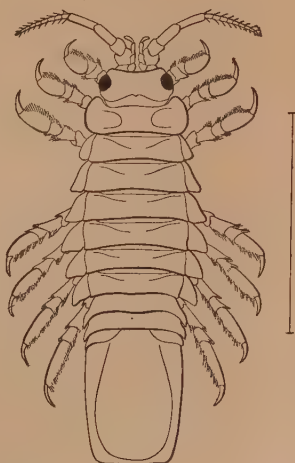
No. 951.

Fig. 34.



No. 938.

Fig. 30.



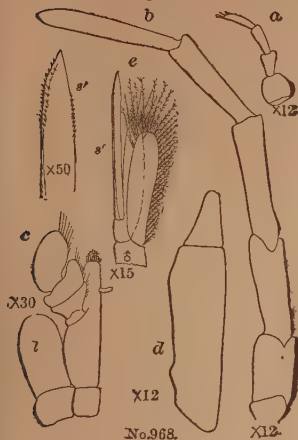
534

PLATE VII.

- FIGURE 37.—*Erichsonia attenuata* Harger (p. 356); *a*, antennula; *b*, antenna, each enlarged twelve diameters; *c*, maxilliped, showing, *l*, external lamella, enlarged thirty diameters; *d*, uropod, or opercular valve, enlarged twelve diameters; *e*, pleopod of the second pair from a male, enlarged fifteen diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged fifty diameters.
- 38.—*Erichsonia filiformis* Harger (p. 355); dorsal view, enlarged five diameters, natural size indicated by the line at the right.
- 39.—The same; *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, uropod, or opercular valve, each enlarged twelve diameters.
- 40.—The same; *a*, maxilla of outer or second pair; *b*, maxilla of inner or first pair; *c*, mandible, showing molar process, *m*, and dentigerous lamella, *d*, all enlarged thirty diameters.
- 41.—The same; *a*, maxilliped, showing, *l*, external lamella; *m*, basal segment, and 1, 2, 3, 4, segments of palpus, enlarged thirty diameters; *b*, pleopod of the second pair from a male, enlarged fifteen diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged fifty diameters.
- 42.—*Epelys trilobus* Smith (p. 358); dorsal view, enlarged ten diameters; natural size indicated by the line at the right.
- 43.—The same; *a*, maxilliped from the left side, enlarged twenty diameters; *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus of maxilliped; *b*, pleopod of second pair from a male, enlarged twenty diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, end of stylet, enlarged fifty diameters.

(All the figures were drawn from nature by O. Harger.)

Fig. 37.



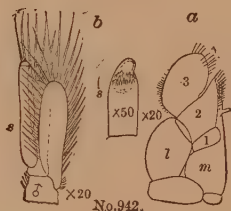
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Fig. 40.



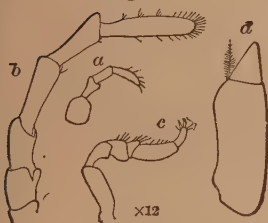
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Fig. 43.



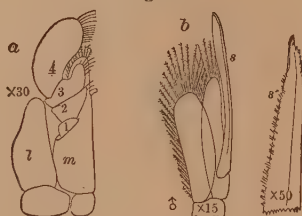
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Fig. 39.



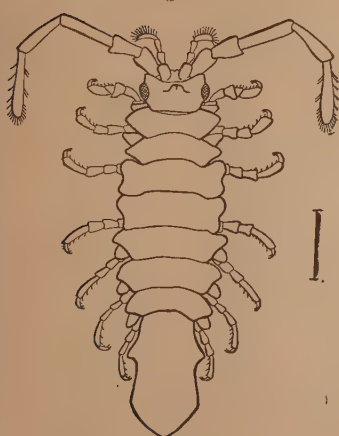
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Fig. 41.



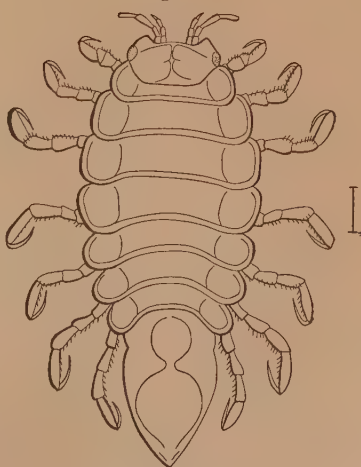
No. 939

Fig. 38.



No. 784.

Fig. 42.



No. 783





PLATE VIII.

FIGURE 44.—*Epelys montosus* Harger (p. 359); dorsal view, enlarged six diameters, natural size indicated by the line at the right.

45.—The same; *a*, antennula; *f*, flagellar segment; *b*, antenna; *c*, maxilliped from the left side; *l*, external lamella; *m*, basal segment; 1, 2, 3, segments of palpus; all the figures enlarged twenty diameters.

46.—The same; *a*, leg of the first pair, enlarged twenty diameters; *b*, right uropod or opercular valve, enlarged fifteen diameters.

FIGURE 47.—The same; pleopod of the second pair, from a male, enlarged twenty diameters; *s*, stylet, articulated near the base of the inner lamella; *s'*, distal end of stylet, enlarged sixty-six diameters.

48.—*Astacilla granulata* Harger (p. 364); female; dorsal view, enlarged four diameters, natural size indicated by the line at the right; *a*, antennula of male; *b*, fourth thoracic segment of male; *c*, inferior surface of pleon of a male, showing opercular valves; all the figures enlarged four diameters.

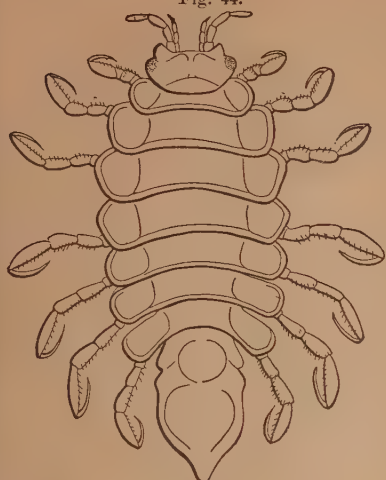
49.—The same; *a*, flagellum of antenna, enlarged twenty diameters; *a'*, portion of inner margin of the same, enlarged one hundred diameters; *b*, one of the first pair of legs, upper surface, enlarged twenty diameters.

50.—The same; one of the fourth pair of legs, enlarged twenty diameters.

51.—The same; inner surface of left opercular plate, or uropod, from a female, enlarged twenty diameters.

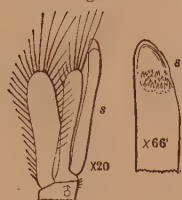
(All the figures were drawn from nature by O. Harger.)

Fig. 44.



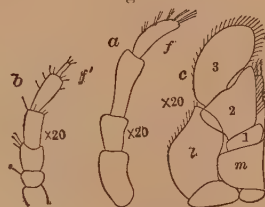
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Fig. 47.



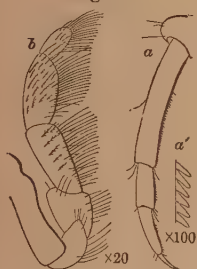
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Fig. 45.



No. 937.

Fig. 49.



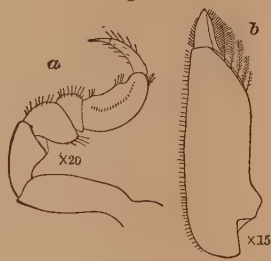
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Fig. 51.



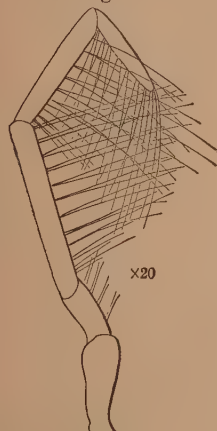
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Fig. 46.



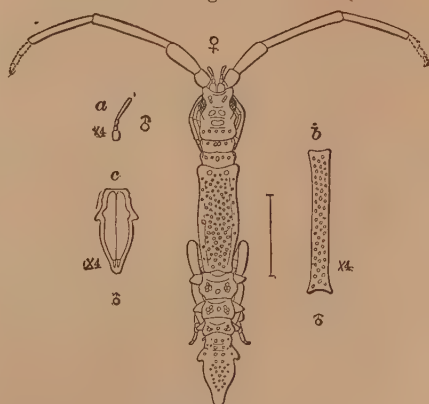
No. 965,

Fig. 50.



No. 494

Fig. 48.



No. 936.

PLATE IX.

- FIGURE 52.**—*Astacilla granulata* Harger (p. 364); *a*, maxilliped; *m*, basal segment; *l*, external lamella; *b*, outer maxilla; *c*, inner maxilla; all enlarged twenty diameters.
- 53.—*Sphæroma quadridentatum* Say (p. 368); dorsal view, enlarged five diameters; natural size indicated by the line at the right.
- 54.—The same; *a*, antennula; *b*, antenna; *c*, pleopod of the second pair, from a male, showing stylet, *s*, articulated near the base of the inner lamella; all the figures enlarged ten diameters.
- 55.—*Limnoria lignorum* White (p. 373); dorsal view, enlarged ten diameters; natural size indicated by the line at the right.
- 56.—The same; *a*, antennula; *b*, antenna; *c*, maxilliped; *d*, maxilla of the outer or second pair; *e*, maxilla of the inner or first pair; *f*, mandible, all enlarged twenty-five diameters; *e'*, distal end of outer lobe of first pair of maxillæ, enlarged sixty-six diameters.
- 57.—The same; *a*, last segment of pleon, with attached uropods; dorsal view, enlarged ten diameters; *b*, uropod with dotted adjacent outline of last segment of pleon, enlarged thirty diameters; *c*, first pair of pleopods; *d*, pleopod of the second pair, from a male, showing stylet, *s*, articulated to the inner lamella; both figures enlarged twenty diameters.
- 58.—*Cirolana concharum* Harger, (p. 378); lateral view, enlarged about three diameters.

(Figure 53 was drawn by Mr. J. H. Emerton, 55 by Prof. S. I. Smith, 58 by Mr. J. H. Blake, and the others by O. Harger.)

Fig. 52.

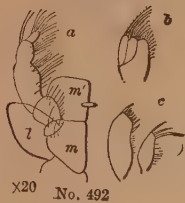


Fig. 53.

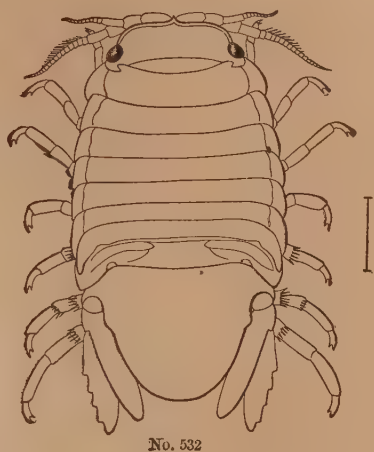


Fig. 57.

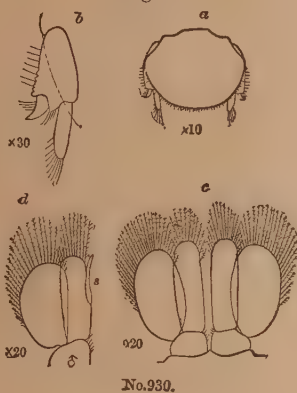


Fig. 54.

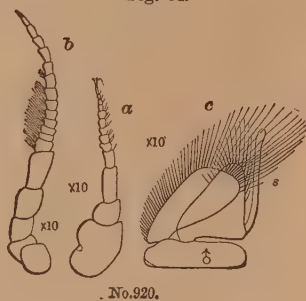


Fig. 56.

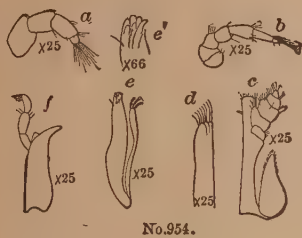


Fig. 55.

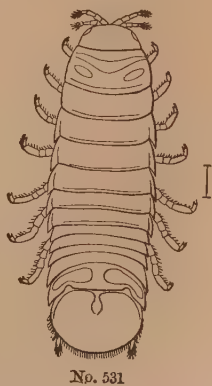


Fig. 58.

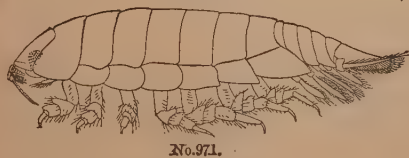


PLATE X.

FIGURE 59.—*Cirolana concharum* Harger (p. 378); dorsal view, enlarged about three diameters. The natural size is shown by the line at the right.

60.—The same; antennula, enlarged ten diameters.

61.—The same; *a*, antenna enlarged ten diameters; *b*, maxilla of the outer or second pair; *c*, maxilla of the inner or first pair; *d*, mandible from the right side, inner view; *p*, palpus; *m*, molar area; the last three figures enlarged five diameters.

62.—The same; *a*, maxilliped from the right side, exterior view, showing, *l*, external lamella; *m*, basal segment; 1, 2, 3, 4, 5, segments of the palpus; *b*, leg of the fourth pair; both the figures enlarged five diameters.

63.—The same; uropod from the right side; inferior view, enlarged five diameters.

64.—*Æga psora* Krøyer (p. 384); *a*, dorsal and *b* ventral views of a young individual. The central line indicates the length of the specimen, natural size, which is here enlarged three diameters. Adults attain about the size of the figure.

FIGURE 65.—*Nerocila munda* Harger (p. 392); dorsal view of the type specimen, enlarged about four diameters. The natural size is shown by the cross on the right; *a*, uropod, enlarged six diameters.

66.—*Ægathoa loliginea* Harger (p. 393); type specimen; *a*, dorsal, and *b*, ventral view, enlarged four diameters. Its natural size is shown by the line between the figures.

(Figure 59 was drawn by Mr. J. H. Blake, the others by O. Harger.)

Fig. 59.

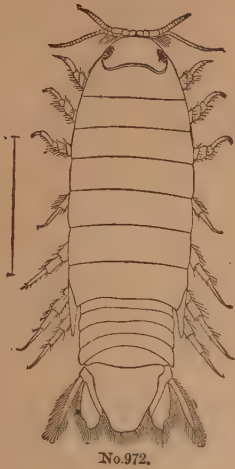


Fig. 60.



Fig. 66.

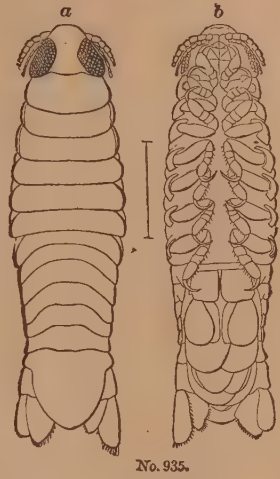


Fig. 63.



Fig. 62.

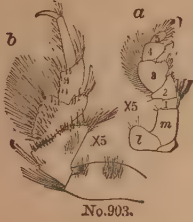


Fig. 61.

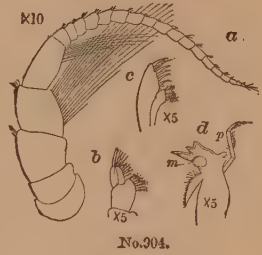


Fig. 65.

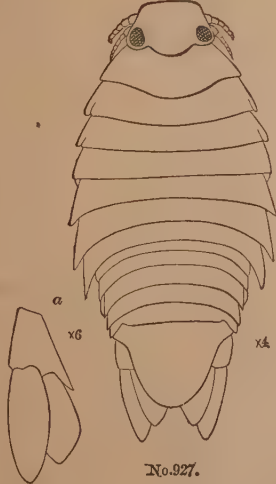


Fig. 64.

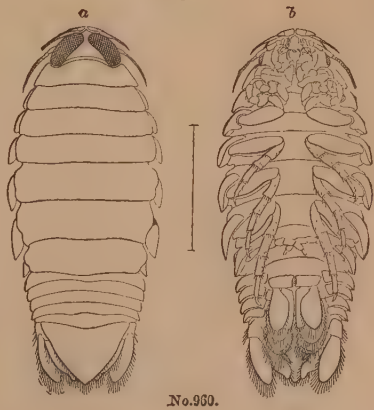


PLATE XI.

- FIGURE 67.**—*Livoneca ovalis* White (p. 395); *a*, antennula; *b*, antenna; *c*, mandibular palpus; each enlarged twenty diameters; *d*, one of the first pair of legs; *e*, one of the seventh pair of legs; *f*, uropod; each enlarged ten diameters. .
- 68.**—*Anthura polita* Stimpson (p. 398); dorsal view, enlarged four diameters. The natural size is shown by the line at the right; *a*, antennula; *b*, antenna, each enlarged ten diameters; *c*, leg of the first pair; *d*, leg of the third pair; *e*, right pleopod of the first pair, interior view, showing inner ramus without cilia; *f*, pleopod of the second pair from a male, showing stylet articulated to inner lamella; each of the figures *c* to *f* enlarged eight diameters; *g*, lateral view of pleon, enlarged six diameters.
- 69.**—The same, *a*, maxilliped, enlarged twenty diameters; *b*, maxilla, enlarged twenty-five diameters; *b'*, distal end of the same, enlarged sixty diameters.
- 70.**—*Paranthura brachiata* Harger (p. 402); dorsal view, enlarged about three diameters; natural size shown by the line at the right; *a*, antennula; *b*, antenna, enlarged eight diameters; *c*, right maxilliped, enlarged sixteen diameters; *d*, maxilla, enlarged sixteen diameters; *d'*, distal end of the same, enlarged fifty diameters; *e*, leg of the first pair; *f*, first pleopod from the right side, inner view, showing ciliated inner lamella; *g*, pleopod of the second pair from a male, showing stylet articulated to the inner lamella; figures *e* to *g* enlarged eight diameters.
- 71.**—*Ptilanthura tenuis* Harger (p. 406); male; dorsal view, enlarged about four diameters; *a*, inferior view of the head and first thoracic segment, enlarged eight diameters; the flagellum of the antennulæ omitted; *b*, maxilliped; *c*, maxilla, each enlarged fifty diameters; *d*, first right pleopod, seen from within, showing ciliated inner lamella; *e*, second left pleopod, showing stylet *s* articulated to the inner lamella in the males.
- 72.**—The same; one of the first pair of legs of a male, enlarged sixteen diameters.
- 73.**—The same; female; dorsal view of the head, enlarged twenty-five diameters.
- (Figure 71, excepting *b-d*, was drawn by Mr. J. H. Emerton, the others by O. Harger.)

Fig. 68.

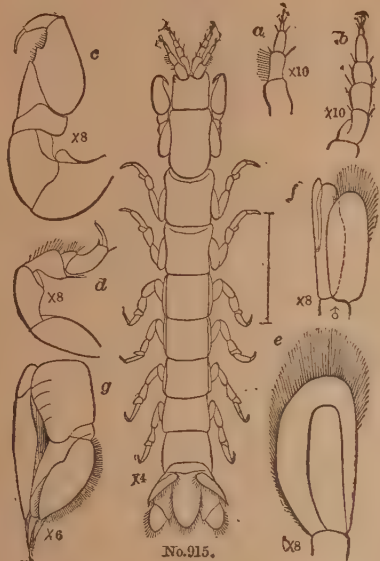


Fig. 67.

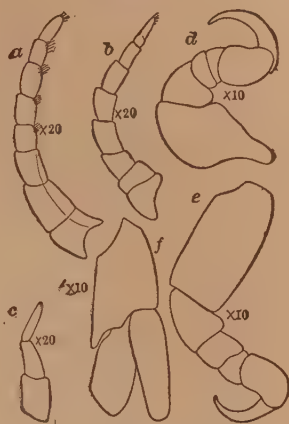


Fig. 69.

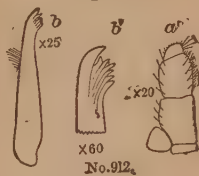


Fig. 72.



Fig. 73.

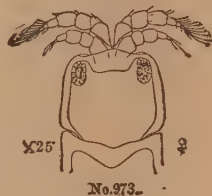


Fig. 70.

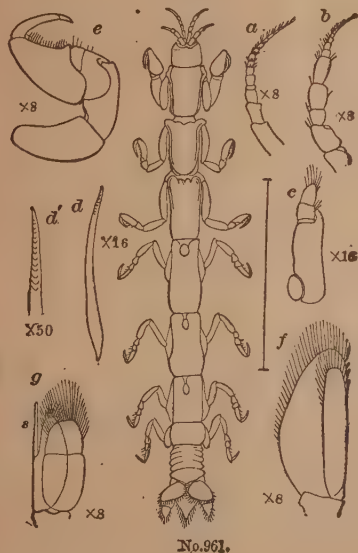


Fig. 71.

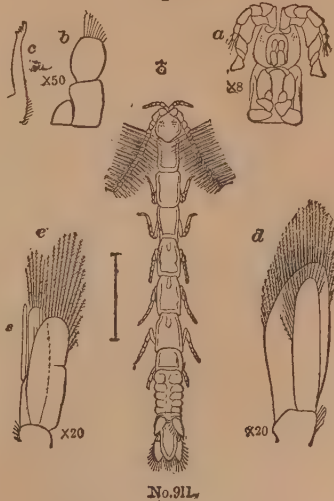


PLATE XII.

FIGURE 74.—*Ptilanthura tenuis* Harger (p. 406); *a*, antennula; *b*, antenna; each enlarged twenty diameters, from a male.

75.—*Gnathia cerina* Harger (p. 410); male; dorsal view, enlarged ten diameters.

76.—The same; *a*, antennula; *b*, antenna, each enlarged thirty-eight diameters; *c*, mandibles (*l*, left, *r*, right), enlarged thirty-eight diameters; *d*, first leg or first gnathopod from the right side, enlarged twenty-five diameters; all the figures from the male sex.

77.—The same (p. 411); female; dorsal view, enlarged ten diameters.

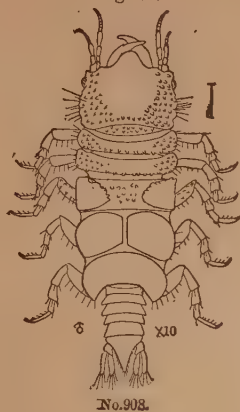
78.—The same; *a*, one of the first pair of legs or first gnathopod of a female, enlarged thirty-eight diameters; *b*, one of the first pair of legs in a young, parasitic individual, enlarged sixty diameters; *c*, pleon, with the last and part of the penultimate thoracic segments of a female, dorsal view, enlarged twenty diameters; *d*, pleopod of a young, parasitic individual, enlarged sixty diameters; *e*, pleopod of an adult male, enlarged sixty diameters.

79.—The same; young male; dorsal view, enlarged twenty diameters.

80.—*Leptochelia algicola* Harger (p. 421); male; lateral view, enlarged twenty diameters; natural size indicated by the line above.

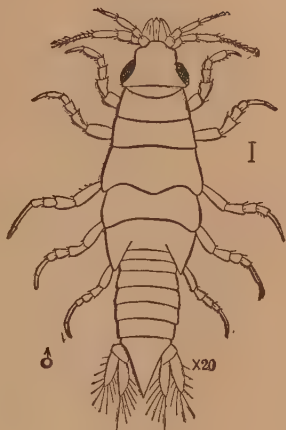
(All the figures were drawn from nature by O. Harger.)

Fig. 75.



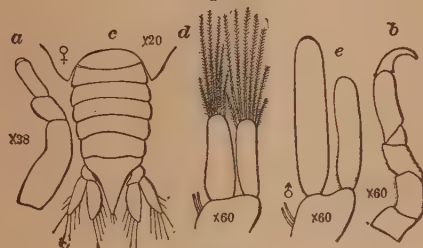
No. 908.

Fig. 79.



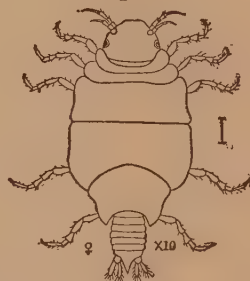
No. 491

Fig. 78.



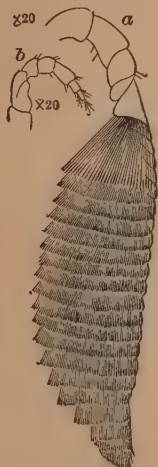
No. 926.

Fig. 77.



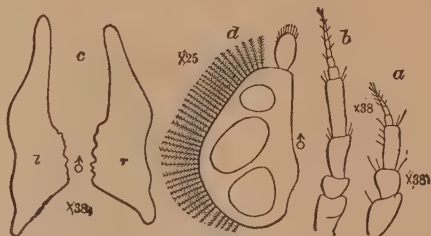
No. 907.

Fig. 74.



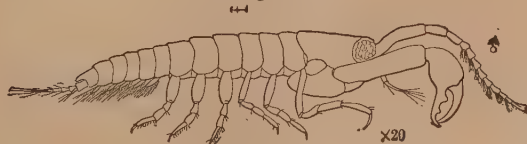
No. 909.

Fig. 76.



No. 919.

Fig. 80.



No. 932.

PLATE XIII.

FIGURE 81.—*Tanais vittatus* Lilljeborg (p. 418); dorsal view, enlarged eight diameters. The transverse bands of hairs on the pleon are not sufficiently distinct.

82.—The same; one of the first pair of pleopods, enlarged thirty diameters.

83.—*Leptochelia algicola* Harger (p. 421); female; dorsal view, enlarged twenty diameters; natural size indicated by the line at the right.

84.—The same; *a*, antennula; *b*, one of the first pair of legs; both from a female specimen and enlarged twenty-five diameters.

85.—The same; hand, or propodus and dactylus of the first pair of legs, enlarged forty-eight diameters, showing the comb of setæ on the propodus.

86.—The same; uropods of a male, enlarged seventy diameters; *b*, basal segment; *i*, inner six-jointed ramus; *o*, outer ramus.

87.—*Leptochelia limicola* Harger (p. 424); female; dorsal view, enlarged twenty diameters; natural size shown by the line at the right.

88.—The same; *a*, antennula; *b*, antenna; *c*, leg of the first pair; *d*, leg of the second pair; all from the female sex and enlarged twenty-five diameters.

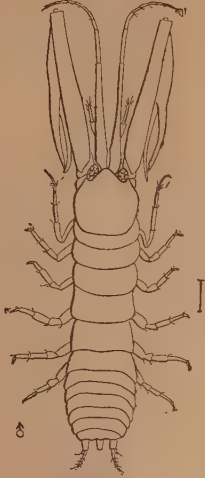
89.—*Leptochelia rapax* Harger (p. 424); male; dorsal view, enlarged about twelve diameters.

90.—The same; hand, or propodus and dactylus of male, enlarged sixteen diameters.

91.—*Leptochelia coeca* Harger (p. 427); type specimen, female; *a*, antennula; *b*, leg of the first pair; *c*, uropod; each enlarged fifty diameters.

(All the figures were drawn from nature by O. Harger.)

Fig. 89.



No. 497.

Fig. 90.



No. 496

Fig. 86.



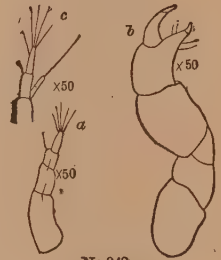
No. 498.

Fig. 85.



No. 902.

Fig. 91.



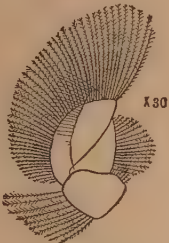
No. 948.

Fig. 88.



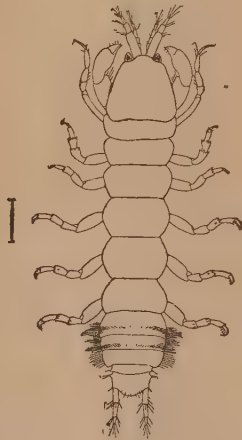
No. 952.

Fig. 82.



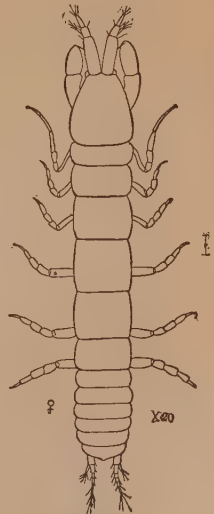
No. 931.

Fig. 81.



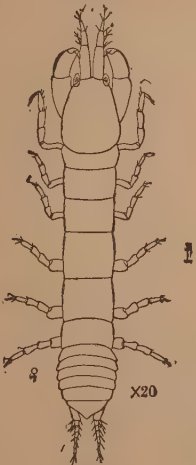
No. 901.

Fig. 87.



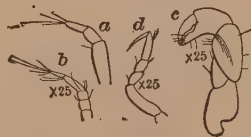
No. 917.

Fig. 83.



No. 933.

Fig. 84.



No. 953.

ALPHABETICAL INDEX TO THE REPORT ON THE MARINE ISOPODA OF NEW ENGLAND AND ADJACENT WATERS.

[In the following index the first reference for the names of the families, genera, and species here described is to the page on which such description is made. The list of authorities, being alphabetically arranged, is not indexed.]

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Description of Lucifer Typus. M. Edw.?

BY WALTER FAXON, *Museum of Comp. Zoölogy of
Harvard College.*

DURING the early part of August a few specimens of the genus *Lucifer* were taken at night with the hand net, at the surface of the water, in the vicinity of Fort Wool, by Mr. August Schmidt.

As far as I know, this is the first record of the occurrence of this interesting genus on our shores. Messrs. Smith and Harger took a few specimens (species undescribed and undetermined) east of George's Bank, Lat. $41^{\circ} 25' N.$, Long. $65^{\circ} 5'$ to $30' W.$, (Note 1.) The described species have come from various points in the Mediterranean, Atlantic, Pacific and Indian Oceans.

DESCRIPTION.

Antennary segment twice as long as the carapace. A small spine (Figure 1, *s'*.) projects from its anterior margin at the base of the eye-stalks.

There is no clear line of demarcation between the antennary segment and the carapace.

Carapace about as long as the first abdominal segment. Its inferior borders crenate. A minute spine on each side. (Figure 1, ζ.)

The first five segments of the abdomen are about equal in size, their latero-inferior margins produced into an obtuse angle at the middle. The sixth segment of the abdomen is almost twice as long as the preceding ones, and is furnished with two teeth on the lower border on either side; the anterior tooth is pointed; the posterior, blunt.

The eye-stalks are clavate, and less than one-half as long as the antennary segment.

The peduncle of the first antennae is composed of a basal segment nearly equal in length to the ocular peduncle, and two short segments. The proximal end of the basal segment is slightly enlarged for the accommodation of the auditory sac with its enclosed otolith. (Figure 1, ε.) (Note 2.) The peduncle bears a long multiarticulate flagellum, the proximal annuli of which are furnished with short setae.

The peduncle of the second antennae is composed of two segments. Of these, the first is very short, and bears a short "olfactory denticle." The second segment is much longer, but not equal to the proximal segment of the first

antennae. The flagellum is apparently about as long as the flagellum of the first pair. The second antennae bear at their base, externally, an "antennal scale," (Figure 1, *d*,) which is fringed with numerous setae, and equals the eye-stalks in length.

The mouth is bounded in front by a large labrum, (Figure 1, *e*; Figure 2, *a*,) then follow a pair of mandibles, (Figure 2, *b*,) and a bilobed metastoma. (Figure 2, *c*,) The first maxillae consist of a small setiferous inner lobe, (Figure 2, *d*'') a larger outer lobe (Figure 2, *d*',) also armed with setae, and a palpus. (Figure 2, *d*''.) The second maxillae (Figure 2, *e*',) possess a "scaphognathite," (Figure 2, *e*',) but their structure was not made out in detail. The first maxillipeds (Figure 2, *f*,) are two-jointed, the terminal segment beset with setae on its inner border.

The second maxillipeds (Figure 1, *f*, Figure 2, *g*,) are made up of six segments, the three distal bent back upon the preceding ones. All the segments of this appendage and the four following pairs bear scattered setae.

The four following pairs of appendages (third maxillipeds and first, second and third "decapodal" legs,) are bent forward. The second pair is the shortest, next in length comes the first pair, next the third, the last being the longest, and furnished with a minute claw at the extremity.

There is no trace of the fourth and fifth pair of "decapodal" legs, nor of outer branches on any of the thoracic pairs.

The first pair of abdominal appendages in this (male) specimen are armed with the peculiar prehensile organ (Figure 1, *m'*,) which is commonly found in the males of this genus. It consists of a movable piece (Figure 3, *a*,) which closes upon a blunt process, (Figure 3, *b*,) tipped with minute teeth. There is but one terminal branch.

The second pair of abdominal appendages have three terminal branches, (Figure 1, *n'*, *n''*, *n'''*,) the remaining four pairs possess two terminal branches. The outer branch of the last pair (Figure 1, *r'*,) is longer than the inner branch, (about one-third longer than the telson,) and is produced at postero-lateral angle into a sharp tooth. The terminal branches of all the abdominal limbs are furnished with setae, excepting the short plate-like third branch of the second pair, (Figure 1, *n'''*,.)

Length, 9 millimetres.

The single specimen obtained agrees in most respects with the description of the earliest known species by J. R. Thompson, (Note 3.) It differs noticeably, however, in the shorter eye-stalks. In this it agrees better with *Lucifer Regnaudii*, M. Edw., (Note 4.) In view of the unsatisfactory description of the known species, I have thought best not to impose a new specific name upon this

specimen until sufficient material is at hand for a critical revision of the species.

CAMBRIDGE, *January 9th, 1879.*

NOTES.

1. Report on the Dredgings in the region of St. George's Banks, in 1872. By S. J. Smith and O. Harger. Trans. Conn. Acad. Arts and Sci., III, 26, 1874.

2. The auditory apparatus of *Lucifer* was first observed by SOULEYET, (Comptes Rendus, XVII, 665, *note*, 1843; Froriep's Neue Notizen, XXVIII, 84, *note*, 1843.) Later it was described and figured by HUXLEY. (Notes and Observations made on board H. M. S. Rattlesnake during the years 1846-50. Ann. Mag. Nat. Hist., 1851, p. 305, Pl. XIV, Fig. 1.) *Cf.* also, KRÖYER, Forsøg til en monographisk Fremstilling af Kræbsdyrslægten Sergestes. Med Bemærkninger om Dekapodernes Høreredskeer. Kong. Dansk. Vidensk. Selsk. Skrifter. V, Naturvidensk og Math., Afd. IV, 293, Tav. V, Fig. 20, 1859. HEUSEN, Studien über das Gehörorgan der Decapoden. Zeits. Wiss. Zool., XIII, 383, 1863.

3. Zoölogical Researches and Illustrations, p. 58, Pl. VII, Fig. 2, 1829. Thompson's specimen was taken in the Atlantic, Lat. 11° 56' N., Long. 32°

55' W. He described it under the generic name simply. The trivial name *typus* was given later by Milne Edwards, (Hist. Nat. des Crustacés, II, 469, 1837.)

4. *Loc. cit.*, Pl. 26, Fig. 10. From the Indian Ocean.

Besides the above cited works, *cf.*, with reference to *Lucifer*, DANA, Crust. U. S. Explor. Exped., pp. 668-675, Pl. 44, Fig. 9; 45, Figs. 1-3, 1852.

SEMPER, Zeits. Wiss. Zool., XI, 106-107, 1862.

CLAUS, Ueber einige Schizopoden und niedere Malacostruken Messina's. Zeits. Wiss. Zool. XIII, 433-437, Taf. XXVIII, Fig. 21-26, 1863.

A. DOHRN, Untersuchungen über Bau und Entwicklung der Arthropoden. Zeits. Wiss. Zool., XXI, 356-359, Taf. XXVII, Fig. 1-10, 1871.

WILLEMÖES-SUHM, "Preliminary Remarks on the Development of some Pelagic Decapods." Ann. Mag. Nat. Hist., XVII, 163, 1876. (An interesting note on the development of *Lucifer*, showing that Dana's genus *Erichthina* is a young stage of *Lucifer*. See also, CLAUS, Untersuchungen zur Erforschung der genealogischen Grundlage des Crustacien-Systems, p. 40, 112, 113, 1876.)

STREETS, Contr. to the Nat. Hist. of the Hawaiian and Fanning Islands and Lower California Bull. U. S. National Museum, No. 7, p. 122, 1877.

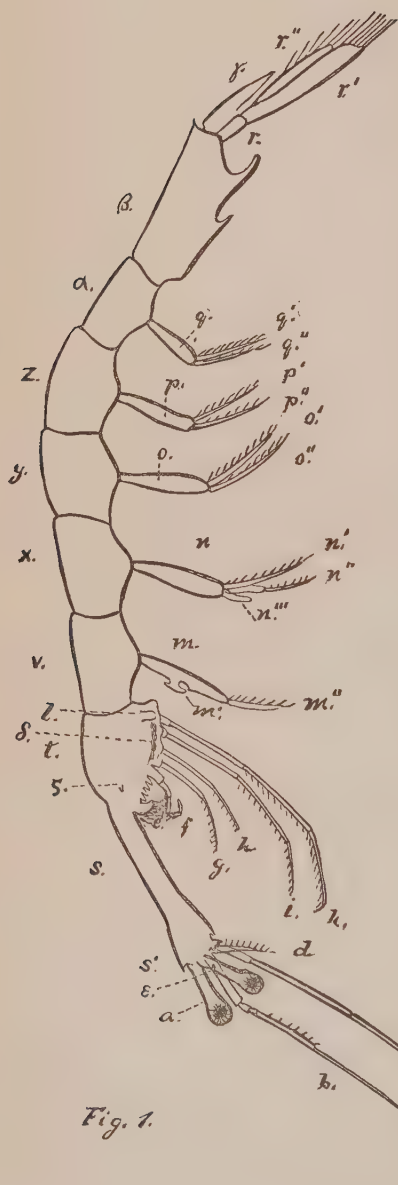


Fig. 1.

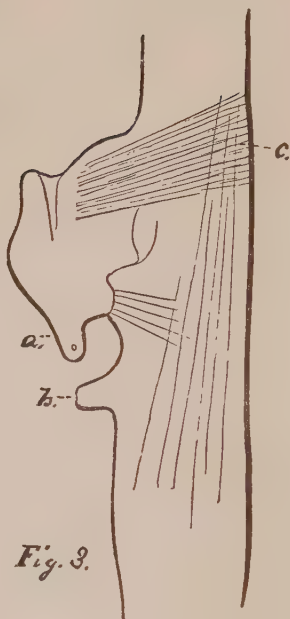


Fig. 3.

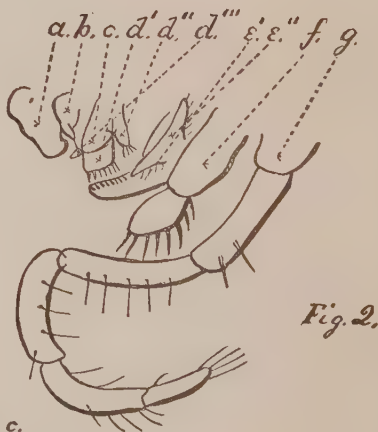


Fig. 2.

EXPLANATION OF FIGURES.

FIGURE 1.—*Lucifer typus* M. Edw.? 9 mm. in length. *a*, eye-stalk; *b*, antenna of first pair; *c*, antenna of second pair; *d*, "scale" of second antenna; *e*, labrum; *f*, second maxilliped; *g*, third maxilliped; *h*, *i*, *k*, appendages corresponding to the first, second and third pairs of legs of the higher Decapods; *l*, sac at the end of the *vas deferens*? *m*, first abdominal appendage; *m'*, copulatory organ on the first abdominal appendage; *m''*, terminal branch of the first abdominal appendage; *n*, *n'*, *n''*, *n'''*, second abdominal appendage with its three terminal branches; *o*, *p*, *q*, third, fourth and fifth abdominal appendages with their two terminal branches; *r*, *r'*, *r''*, basal segment, outer and inner branches of the sixth abdominal appendage; *s*, antennary segment; *s'*, spine on antennary segment; *t*, carapace; *v*, *x*, *y*, *z*, α , β , first to sixth abdominal segments; γ , telson; δ , nervous cord in the thorax; ϵ , auditory organ in basal segment of first antenna; ζ , spine on the carapace.

FIGURE 2.—Do. Mouth-parts of left side. *a*, labrum; *b*, mandible; *c*, metastoma; *d'*, outer lobe of first maxilla; *d''*, inner lobe of first maxilla; *d'''*, palpus of first maxilla; *e'*, second maxilla; *e''*, scaphognathite; *f*, first maxilliped; *g*, second maxilliped.

FIGURE 3.—Do. Prehensile male organ on the anterior border of the first pair of abdominal appendages, $\frac{1}{8}$ inch object. *a*, movable piece which closes upon the process *b*; *c*, muscles which move *a*.

No. 15.— *On the Development of PALÆMONETES VULGARIS.*
By WALTER FAXON.

THE observations recorded in this paper were made during the summers of 1876 and 1877 in the laboratories of Mr. Alexander Agassiz, at Newport, R. I., and of the United States Commission of Fish and Fisheries, at Wood's Hole, Mass. I am under great obligations to Mr. Agassiz, and Professor S. F. Baird, United States Commissioner of Fish and Fisheries, for placing at my disposal every means for the collection and study of specimens.

The difficulty of rearing the larvæ of *Crustacea* in confinement, and the uncertainty of finding all the stages in the development of a species by collecting with the hand-net or tow-net, perhaps account for the fact that we have so few life-histories of Decapod *Crustacea* which are in any way complete.

The common prawn of our coast, *Palæmonetes vulgaris* Stimpson, is one of the most typical of the long-tailed Decapods, and affords an excellent opportunity for obtaining the life-history of a Macrouran, which undergoes a metamorphosis after quitting the egg. The present paper is a contribution to that history.

The opacity of the eggs and larvæ making it impossible to follow the development of the internal organs in detail, I have confined myself chiefly to the growth of the hard parts.

This species was first described by Say, in 1818, under the name of *Palæmon vulgaris*;* again described, and figured for the first time, by De Kay, in 1844.† In 1869, the genus *Palæmonetes* was established by Heller for the reception of *Palæmon varians* Leach, from the North Sea and fresh waters of the Mediterranean basin.‡ It differs from *Palæmon* in lacking mandibular palpi. In the armature of the carapace it agrees with *Palæmon*, subgen. *Leander*, i. e. an antennal and a branchiostegal spine are present, but no hepatic spine.

* An Account of the *Crustacea* of the United States. Jour. Acad. Nat. Sci. Phila., Vol. I. pp. 248, 249. 1818.

† Zoölogy of New York, Part VI. *Crustacea*, pp. 29, 30, Pl. IX. Fig. 30. 1844.

‡ Zur näheren Kenntniss der in den süßsen Gewässern des südlichen Europa vorkommenden Meerescrustaceen. Zeitschr. wissensch. Zool., Vol. XIX. p. 160. 1869.

Our species was properly placed in the genus *Palæmonetes* by Stimpson in 1871.*

A figure of the adult, by J. H. Emerton, is given on Plate II. of Verrill and Smith's "Report upon the Invertebrate Animals of Vineyard Sound and the Adjacent Waters," and on page 235 of the same work is a description of the first larval stage by Smith.†

This species is common in shallow water along the eastern coast of the United States from Hampton, N. H. (! Coll. Mus. Comp. Zool.), to the St. John's River, Fla. (G. Brown Goode). It is especially common on sandy bottoms among the eel-grass, where, as Verrill well observes, its color admirably adapts it for concealment.‡ It ascends far up into the brackish water of estuaries and rivers. I have found it abundant in the Charles River marshes, Cambridge, Mass., and Mr. G. Brown Goode collected it in the St. John's River, Fla., twenty-two miles from the mouth, where the water was perfectly fresh to the taste.§ On the coast of New Jersey and the Carolinas it is associated with a nearly allied species, *Palæmonetes Carolinus* Stimpson.|| It is represented in the fresh waters by a smaller and slenderer species, *Palæmonetes exilipes* Stimpson,¶ which has a wide distribution in the rivers and lakes of the Western and Southern States.

* Notes on North American *Crustacea* in the Museum of the Smithsonian Institution, No. III. Ann. Lyc. Nat. Hist. N. Y., Vol. X. p. 129. 1871.

† Report on the Condition of the Sea Fisheries of the South Coast of New England in 1871 and 1872, p. 529, Pl. II. Fig. 9. 1873. The description of the larva also appears in Smith's "Early Stages of the American Lobster (*Homarus Americanus* Edwards)." Trans. Conn. Acad., Vol. II. p. 377. 1873.

‡ *Op. cit.*, p. 479.

§ *Vide* S. I. Smith's "Stalk-eyed Crustaceans of the Atlantic Coast of North America north of Cape Cod." Trans. Conn. Acad. Arts and Sci., Vol. V. p. 37. 1879.

|| *Op. cit.*, p. 129.

¶ *Op. cit.*, p. 130. This is probably the species described, from imperfect specimens, under the name of *Hippolyte paludosa*, by Gibbes, in 1850 (On the Carcinological Collections of the Cabinets of Natural History in the United States. Proc. Amer. Ass. Adv. Sci., 1850, p. 197), as claimed by Kingsley (Notes on the North American *Caridea* in the Museum of the Peabody Academy of Science at Salem, Mass. Proc. Acad. Nat. Sci. Phila., 1878, p. 97).

I observe in an ovigerous female of this species from Kentucky, preserved in alcohol, that the eggs are much larger in size and fewer in number than those of *Palæmonetes vulgaris*. While the eggs of the latter, shortly after laying, measure about .5 mm. in long diameter, those of the former (the embryo has seemingly hardly begun to form) measure 1.25 mm. in length. Whether the fresh-water *Palæmonetes* hatches from the egg in a more advanced phase of development than its marine rela-

In June, July, and the early part of August, the females of *Palæmonetes vulgaris* may be found carrying their eggs (which will afford different phases of development in different individuals simultaneously) fixed to the hairs on the peduncle * of the abdominal appendages, from the first to the fourth pair inclusive. Here they receive not only the protection of the parent, but also a constant aëration by means of the gentle backward and forward movement of the abdominal appendages. This aëration of the eggs seems to be essential to their development, for if detached from the mother they invariably die, unless the enclosed embryo has very nearly reached the point of hatching.

All the eggs are not attached directly to the appendages of the abdomen, as in *Astacus*, but many of them are joined to one another by delicate threads drawn out from the secretion which invests each egg. Thus large clusters are formed, in which comparatively few eggs are fixed immediately to the abdominal appendages. These clusters, again, are different from the botryoidal clusters so common among the *Brachyura*, in which the eggs are only indirectly connected with each other through the mediation of a common stalk from which the eggs depend by short pedicels.

Soon after the escape of the young the parent prawn casts her integument, thus ridding herself of the egg-shells which are indissolubly fastened to her legs. I have found this moult to take place almost invariably within a few hours after the hatching of the eggs.† Commonly this happens in the night, morning discovering the newly-hatched brood of zoëæ collected at the surface of the aquarium, on the side toward the light, and the discarded integument of the parent prawn sunk to the bottom. I have never seen the prawn practise that economy observed in certain insect larvæ, which devour their cast-off skin.

The newly-laid eggs are elliptical, about .5 mm. in long diameter.

tive, is an interesting question for our Western zoölogists to answer. The young of the fresh-water *Caridina Desmarestii*, as we know from the observations of Joly (Études sur les Mœurs, le Développement et des Métamorphoses d'une petite Salicoque d'Eau Douce (*Caridina Desmarestii*). Ann. Sci. Nat., 2d series, Vol. XIX. 1843), are hatched as zoëæ, and undergo a subsequent metamorphosis before attaining the adult form.

* Not to the inner branches, as is stated to be the case with *Palæmon serratus*, by J. V. Thompson (Memoir on the Metamorphoses in the *Macroura* or Long-tailed Crustacea, exemplified in the Prawn (*Palæmon serratus*). Edinburgh New Philosophical Jour., Vol. XXI. p. 223. 1836).

† Joly observed the same thing in *Caridina Desmarestii* (op. cit., p. 55).

The gluey secretion which attaches the eggs to the abdominal limbs of the mother hardens into a structureless membrane, which invests each egg so closely that it is difficult to separate it from the proper egg-membrane. The yolk is of a greenish color, heavily charged with deutoplasmic elements in the shape of minute granules and larger spherical vesicles, intermixed with oil-globules.

The cleavage of the egg begins in two planes almost simultaneously. These planes are at right angles with each other, passing through the long and the short axes of the egg. The egg is thus divided into four cleavage-spheres, each provided with a nucleus and nucleolus. Delicate lines of protoplasm extend like rays from the nuclei into the surrounding yolk (Pl. I. Fig. 1).

The opacity of the eggs prevented my determining whether the cleavage passed completely through the yolk.*

The cleavage proceeds regularly (Plate I. Fig. 2), forming eight, six-

* Bobretzky, who has made sections of the eggs of *Palæmon*, is uncertain how deep the clefts enter the yolk in the earliest stages of segmentation, owing to the imperfection of his sections. (On the Embryology of Arthropods [in Russian]. *Zapiski Kievs. Obshtshest. Yestestvoisпитatelyei*, Vol. III. p. 190. 1873. A short and unsatisfactory abstract of Bobretzky's paper, in German, by Hoyer, appears in Hofmann and Schwalbe's "Jahresberichte," Vol. II. pp. 312-318. 1875. I have had certain parts of the original paper translated from the Russian for me by Mr. Ivan Panin.) By the time that 128 cleavage products are formed they have the shape of long pyramids, whose apices are fused in the common undivided granular mass at the core of the egg, while the clear protoplasm, involving the nuclei, collects at the surface of the egg, in the bases of the pyramids. Later the boundaries of the pyramids become obliterated, and their protoplasmic bases thus form a cellular superficial blastoderm, enclosing the opaque nutritive yolk (Pl. V. Fig. 18 *et seq.*).

In *Crangon vulgaris*, according to E. Van Beneden (*Recherches sur la Composition et la Signification de l'Œuf*. *Mém. Cour. Acad. Roy. Belg.*, Vol. XXXIV. p. 142, Pl. X. Fig. 20. 1870), the cleavage is at first total, then a separation takes place between the deutoplasm and the protoplasm of the vitelline segments; the former accumulating at the centre of the egg, the latter, carrying with it the nuclei of the segments, is borne to the periphery to constitute the cells of the blastoderm.

The egg of *Peneus (membranaceus?)*, as observed by Haeckel (*Die Gastrula und die Eifurchung der Thiere*. *Jenaische Zeitschr. f. Naturwissenschaft*, Vol. IX. pp. 447, 448, Pl. XXIII. Fig. 82), in the stage with four cleavage-cells, showed on cutting that the furrows extended less than half-way to the centre of the egg, leaving a large, elliptical, central mass of nutritive yolk undivided.

In *Eupagurus Prideauxii*, as we learn from P. Mayer (*Zur Entwicklungsgeschichte der Dekapoden*. *Jenaische Zeitschr. f. Naturwissenschaft*, Vol. XI. p. 212, Pl. XIII. 1877), eight segments, completely separated from one another, are formed before the segregation of the deutoplasm from the protoplasm begins.

teen, thirty-two segments, and so on, until the whole surface of the egg is made of minute, polygonal cells (perimorula). No polar globules are emitted.*

Twenty-four hours after the cleavage began, an egg was found in the gastrula-stage, as represented on Plate I. Fig. 3. The cavity is very small compared with the size of the egg, and its orifice (*g*) is bounded by elliptical cells, which form a light-colored disk on the surface of the egg. The orifice apparently closed a little later, and the further history of the cavity was not obtained.

The yelk now shrinks away from its membrane in the vicinity of the light-colored disk, and becomes transparent and free from granules preparatory to the appearance of the parts of the embryo.

The parts of the embryo which first appear are the abdomen, the labrum and cephalic disks, and the first three pairs of appendages. These appear almost simultaneously. A protuberance from the surface of the yelk, near the place where the gastrula opening appeared, is the rudiment of the abdomen. Another fold over against the first is the beginning of the formation of the labrum, and in front of this two disks appear, which are the first trace of the eyes and front part of the head of the embryo.

The projection of the two folds which form the abdomen and labrum is such that the free ends are toward one another. Thus the abdomen, from the time of its earliest appearance, is bent forward underneath the breast of the future prawn. On each side of the labrum and abdomen are three lobes, which are the rudiments of the two pairs of antennæ and the mandibles. The first pair are on a level with the labrum, the third pair with the end of the abdomen. All three pairs are simple. This is the nauplius-stage of the embryo.†

* P. Mayer observed occasionally in fresh-laid eggs of *Eupagurus* "a sort of *Richtungsbläschen*," but he considers these cases abnormal. They were probably the result of disintegration of the egg (*op. cit.*, p. 223).

† Joly's account of the order of appearance of the appendages of the embryo of *Caridina*, — first, the three pairs of thoracic legs (i. e. the maxillipeds), then the maxillæ, mandibles, and antennæ, — is without doubt incorrect (*op. cit.*, pp. 59, 60). In an abstract of a paper "On the Development of the Crustacean Embryo, and the Variations of Form exhibited in the Larvæ of 38 Genera of Podophthalmia" (Proc. Royal Soc. London, Vol. XXIV. p. 378. 1876), Spence Bate states his belief "that he has demonstrated that the three pairs of mobile appendages in the cirripedal or *Nauplius* form of larva homologize with the eyes and two pairs of antennæ, and not with the antennæ and mandibles, as stated by Fritz Müller, Anton Dohrn, and others." (!) It is to be hoped that the evidence will not long be withheld from publication.

The appendages back of the mandibles now appear in regular succession in the form of hyaline protuberances from the opaque yelk. Four days after the gastrula-stage (Pl. I. Fig. 3), the embryo has the form portrayed on Plate I. Fig. 4.

The rudiments of the appendages have appeared as far back as the sixth pair (first pair of maxillipeds). The second pair of antennæ (Pl. I. Fig. 4, *II*), are now double appendages, the two parts representing the flagellum and scale of the future antenna. The appendages behind the mandibles are bilobed from the time of their earliest appearance. The labrum (*lb*) has moved backward, so as now to lie on a line with the second pair of antennæ.

The antennæ rapidly increase in length, assuming the form of ribands which lie along the outer side of the following appendages, parallel with the abdomen. Three days after the stage last described they reach as far back as the first pair of maxillipeds (Pl. I. Fig. 5). The first pair (*I*) lie on the outer side of the second pair (*II*), and are slightly shorter than these. The outer branch of the second pair, again, is a little longer than the inner branch. Even at this early period traces of setæ are seen on the extremities of both pairs of antennæ. The rudiments of the appendages are now formed as far back as the third pair of maxillipeds (Pl. I. Fig. 5, *VIII*), the abdomen (*ab*) extends forward so far as to meet the labrum (*lb*), but is still unformed along the median dorsal line. Some scattered blotches of a dark color (*oc*) are the first indications of the pigment of the compound eye.*

On the following day (Aug. 5) I observed the first appearance of the median simple eye in the form of a black pigment-spot in the middle line of the head.

The embryo gradually encroaches upon the unabsorbed yelk-mass on the dorsal side of the egg. The outline of the carapace (Pl. I. Fig. 6, *cp*, four days before hatching) comes into view, extending posteriorly beyond the third pair of maxillipeds. Under the posterior part of the carapace the heart appears as a transparent pulsating sac (*ht*). The abdomen (*ab*) becomes divided into segments by transverse constrictions which begin on the ventral side, the side which is applied to the ventral face of the cephalo-thorax of the embryo. Within the abdomen are seen the ganglia of the nervous system (Pl. I. Fig. 6, *ng*). The end of the abdomen is produced into two blunt lobes, on the borders of which the setæ are already visible.

* The development of the eye certainly lends no countenance to the view that its stalk is an appendage homologous with the antennæ, etc.

Plate I. Fig. 8, represents an embryo further advanced. The abdomen has lengthened to such an extent that it entirely conceals the labrum, and extends forward so as to almost meet the tip of the rostrum (*rs*), which lies bent beneath the head. The maxillipeds have increased in length, and extend forward as two-branched appendages on each side of the abdomen. At the base of the rostrum is the simple median eye (*ocl*); the permanent eyes (*oc*) show through the egg-shell as oval black spots.

In the still older embryo in the egg represented on Plate I. Fig. 9, the unabsorbed yelk (*vt*) has so diminished as to appear as a large greenish patch on the dorsal side of the embryo. The whole margin of the carapace is clearly defined, and its posterior or cardiac portion is unobscured by underlying yelk. The eyes (*oc*) now form two black roundish spots at the anterior end of the embryo, so large that they are very conspicuous to the naked eye. The corneæ and cones are now formed, and the eye is thrust out a little upon a very short stalk. The antennæ of the first pair (*I*) are divided into two segments, a long proximal and a short oval distal one. The latter is furnished with a few setæ at its tip. The two branches of the second antennæ (*II*) are also tipped with setæ.

In the course of the development of the embryo within the egg, the egg has become larger than it was when first laid. A few hours before hatching (Pl. I. Fig. 10), it measures 1 mm. in long diameter. A small patch of yellowish green (*vit*) just behind the eyes is the only remnant of the unabsorbed yelk. The abdomen (*ab*) has lengthened to such an extent that it reaches far beyond the mouth, between the eyes, to the dorsal side of the head. The basal segment and the two branches of the second pair of antennæ are now clearly defined, and have acquired very nearly the form which they have in the larva after hatching. The maxillipeds have grown to a very large size, and conceal the oral appendages in front of them.

Embryos removed from the egg an hour before hatching (Pl. I. Fig. 11) disclosed two pairs of two-branched sac-like appendages (Figs. 11, 13, *IX*, *X*), concealed between the bases of the third maxillipeds. These are the rudiments of the two pairs of chelipeds of the adult prawn. The structure of the embryo is now the same as during the first larval stage.

First Larval Stage (Pl. I. Figs. 14–18; Pl. II. Fig. 1). — When it first issues from the egg the young prawn is $2\frac{1}{2}$ mm. in length. The carapace is broad, produced between the eyes into a long, pointed rostrum. At the base of the rostrum is a small simple eye. The com-

pound eyes are of huge dimensions, and supported upon short, thick stalks. The abdomen is composed of six segments only, the telson being not yet clearly separated from the preceding segment. The width of the abdomen suddenly diminishes at the fourth segment. The sixth segment consists of a long, cylindrical piece, which terminates in a broad, triangular fin. The hind border of the terminal fin is slightly convex, the angles truncated and notched. It is armed with fourteen long setæ, which are finely feathered on both sides, excepting the outer two pairs, which are feathered only on the inner side. The spaces between the long setæ are slightly concave, and furnished with about four very minute setæ (Pl. I. Fig. 18).* The anus lies on the lower side of the base of the terminal fin, and the intestine shows through the transparent shell as a slender tube passing in a direct line from the stomach to the anus.

The first pair of antennæ (Pl. I. Fig. 15) are short, simple, composed of a large basal segment followed by a small, oval, setiferous, terminal segment. The distal end of the proximal segment also bears a long seta on the inner side of, and longer than, the terminal segment.

The second pair of antennæ (Pl. I. Fig. 16) are about as long as the first pair. They are composed of a short basal segment which bears two branches. The inner branch (*ri*), which develops into the flagellum of the second pair of antennæ in the adult, is a slender piece tipped with a long seta. The outer branch (*re*), which represents the "scale," is at this stage much larger than the inner, divided into segments for some distance from its tip, and furnished with setæ on its inner border.

The mouth is bounded in front by a large, prominent, triangular labrum (Pl. I. Fig. 17, *lb*). The mandibles (Pl. I. Fig. 17, *III*) are slender, and taper gradually to the tips, which are armed with three teeth. There is no trace of a mandibular palpus at any stage in the development.

The first pair of maxillæ (Pl. I. Fig. 17, *IV*), consist of two lobes, the outer of which bears a one-jointed palpus. Both lobes, as well as the palpus, are furnished with setæ on their borders.

The second pair of maxillæ (Pl. I. Fig. 17, *V*; Fig. 12) are composed of an inner plate, the inner edge of which is divided into five lobes, and an outer plate, the scaphognathite, which lies under the carapace and projects far beyond the inner plate toward the eye-stalk. All the lobes are beset with setæ. The scaphognathite is in constant motion,

* The caudal fin of the first zoëa-stage of *Palæmon serratus* is figured by P. Mayer (*op. cit.*, Jena. Zeitschr., Vol. XI. Pl. XV. Fig. 49).

balancing the water out from the branchial chamber before the least trace of the gills has appeared. As the currents of blood in the zoëa stream along the sides of the carapace, they are aerated through the delicate integument by the constant flow of water kept up by the movement of the scaphognathite, which thus plays the same part as in the gill-bearing adult.

Next follow the three pairs of maxillipeds, which, in the early stages of development, serve as swimming-organs. The first pair is the smallest. Its basal segment (Pl. I. Fig. 17, VI) has a strongly convex inner margin, which is beset with setæ. This part of the limb acts as a jaw, while the rest of the limb is used for locomotion. In this the appendage recalls the structure of the limbs in the *Merostomata*. The inner branch is composed of one segment. The outer branch (Pl. I. Fig. 14) is obscurely divided into two segments, and is considerably longer than the inner branch.

The second pair of maxillipeds (Pl. I. Fig. 14, VII) consist in like manner of a basal segment and two branches. The inner branch consists of three segments, of which the proximal and middle are of about equal length, the distal very short. The outer branch is longer than the inner, and is indistinctly divided into five or six segments. Of these the first and second are of equal length, and form together the bulk of the branch. The following segments are crowded together near the tip of the branch, and the lines of division between them can barely be discerned.

The third pair of maxillipeds (Pl. I. Fig. 14, VIII) exceed the second pair in length, but have essentially the same structure. The second pair, again, are longer than the first pair. The branches of all the maxillipeds are furnished with long setæ.

Behind the third pair of maxillipeds are seen the rudiments of the two following pairs of thoracic appendages (Pl. I. Figs. 14, 17, IX, X; Fig. 13). They are two-branched, each branch having the form of a simple sac, without trace of a division into segments.*

There are as yet no traces of abdominal appendages.†

* Du Cane (Ann. Nat. Hist., Vol. II. Pl. VI. Fig. 2. 1839) and Bobretzky (*op. cit.*, p. 204, Pl. V. Fig. 17) both represent the first larval stage of *Palæmon* with the rudiments of the first *three* pairs of walking-feet in the form of *simple* sacs. I am inclined to believe that a more careful dissection would have revealed, in both cases, the structure which I have found in *Palæmonetes vulgaris*, viz. *two* pairs of *double* sacs.

† According to Krøyer (Monografisk Fremstilling af Slægten Hippolyte's nordiske

Just behind the eye-stalks, on the front part of the carapace, are two large blotches of dark pigment. Two similar pigment-spots are seen in most individuals on the hinder part of the carapace, and one in the median line of the body on the dorsal side of the second abdominal segment. The distribution of pigment-spots varies considerably, however, in different individuals.

Second Larval Stage (Pl. II. Figs. 2 - 4). — After the first moult the larva measures 3 mm. from the tip of the rostrum to the end of the abdomen. It now has the same general shape as in the preceding stage, but the carapace is provided with a dorsal spine which is directed forward at the base of the rostrum, and a lateral spine on each side, on the anterior margin. This spine is the supra-orbital of Stimpson's nomenclature.* The posterior margin of the fifth abdominal segment is produced into a tooth-like process on each side.

The first pair of antennæ have acquired an additional (third) segment, but are still simple.

The second pair of antennæ are of the same shape as in the first larval stage, as are also the mandibles and maxillæ.

The maxillipeds have increased in length, and the second and third pairs are longer in proportion to the first pair than they were in the foregoing stage. The first pair have gained a segment in both the inner

Arter. Kongel. Dansk. Vidensk. Selsk. naturvid. og mathem. Afhandl. IX Deel, pp. 245 - 251, Tab. VI. Figs. 120 - 132. 1849), the young of *Hippolyte polaris* extracted from the egg have the five pairs of walking-feet in the form of small, simple, jointed appendages, the first pair with the chela already formed. Five pairs of double abdominal limbs are also present, but no sign of the sixth or posterior pair.

We thus see among the *Caridea* a very great difference in the degree of development in which the larvæ leave the egg. At one extreme we have *Peneus* quitting the egg as a nauplius (Fritz Müller, Die Verwandlung der Garneelen. Arch. f. Naturg., Vol. XXIX. pp. 8 - 23, Taf. II. 1863), at the other *Hippolyte*, provided with all the appendages of the adult excepting the last abdominal. Here the walking-feet are simple from the first, and the larva does not pass through a Schizopod stage. Between these extremes are larvæ like those of *Caridina* (Joly), *Palæmonetes*, etc., which hatch with appendages developed as far back as the third pair of maxillipeds inclusive, or the second pair of walking-feet, and which pass through a *Mysis*-state.

It is to be observed, however, that in the larva doubtfully referred to *Hippolyte* by Claus (Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen-Systems, pp. 44, 45, Figs. 14 - 18. 1876), the rudiments of the walking-feet appear subsequently to the earliest larval stage, — first the two anterior pairs simultaneous with the swimmerets (the earliest to appear of the abdominal limbs), then the three following pairs. Here all the walking-feet of the adult are split-feet in the larva.

* Prodrömus Descriptionis Animalium Evertbratorum, etc. Proc. Acad. Nat. Sci. Phila., 1860, p. 24.

and outer branches, which are now two- and three-jointed respectively. The second and third pairs retain the same number of segments as before.

The anterior of the two pairs of double sac-like appendages, which lay behind the third pair of maxillipeds in the last stage, have disclosed a pair of two-branched swimming-feet (Pl. II. Figs. 2, 3, 4, *IX*). These swimming-feet, which ultimately become the anterior pair of chelipeds in the adult, have about the same structure as the antecedent maxillipeds, but are somewhat shorter.

At the base of the appendages just mentioned are the rudiments of the following two pairs in the shape of small double sacs (Pl. II. Fig. 4, *X*, *XI*). The second pair are very small, and appear now for the first time.

There is still no trace of the abdominal limbs, except in some specimens about to moult, in which the last pair (swimmerets) are visible through the transparent integument within the caudal fin (Pl. II. Fig. 3, *XIX*). They have the shape of oval plates lying within the sides of the triangular telson.

Third Larval Stage (Pl. II. Figs. 5-9). — Larvæ in this stage of development were frequently taken free-swimming at the surface of the water, both at Newport and Wood's Hole, in July and early August. From their slight advance upon the preceding form, I have little doubt of their coming from it by a single moult, although I did not succeed in raising this stage in confinement.

In general form the larva still bears a close likeness to the stage last described. The telson, however, has lost its broad, triangular shape, and now, flanked by the free, bilobed swimmerets, renders this stage distinguishable at a cursory glance from either of the preceding ones.

In addition to the spines seen on the carapace in the second larval stage, there is now a minute one on the anterior border, below the supra-orbital spine. This seems to correspond to the antennal spine in the adult.

The first pair of antennæ are no longer simple, the rudiments of the inner flagellum having appeared as a small bud (Pl. II. Fig. 5, *I, r i*) from the inner side of the distal end of the second segment. It is tipped by a long seta. The segment which terminated the simple antennule of the previous stage now appears as the rudimentary external flagellum (Pl. II. Fig. 5, *I, r e*).

In the second pair of antennæ the inner branch (Pl. II. Fig. 5, *II, r i*), which becomes the chief part of the antenna in the adult, has

become divided by a transverse suture near its base, so that it now consists of two segments, a short proximal and a long, slender, distal one. The external branch of the second antennæ (Pl. II. Fig. 5, *II*, *r c*) has increased in size, but otherwise has suffered little modification.

The posterior border of the labrum, which bounds the mouth in front (Pl. II. Fig. 7), when viewed under a high magnifying power is seen to be serrate with minute teeth.

The mandibles and maxillæ (Pl. II. Figs. 5, 8, 9) have undergone little change.

A fifth pair of swimming-feet (Pl. II. Fig. 5, *X*) has developed from the anterior of the sac-like buds behind the last pair of swimming-feet of the preceding stage. This pair of swimming feet corresponds to the second or larger pair of chelipeds of the adult *Palæmonetes*. They are similar in make to the preceding pairs, but somewhat shorter. The antecedent pair of swimming-feet have gained in length, so that they now equal, if they do not slightly exceed, the pair in front of them. The segmentation of the inner branches of all the swimming-feet is more distinct than at first, dividing them into four segments, at least in the hindmost three pairs.

A new pair of sac-like appendages (Pl. II. Fig. 5, *XII*?) have developed behind the swimming-feet, so that we still have two pairs (*XI* and *XII*?), which will disclose swimming-feet after the next moult. The gills have begun to develop at the base of the swimming-feet.

The broad triangular fin which terminated the abdomen in the last stage has by exuviation freed the posterior pair of abdominal appendages (Pl. II. Fig. 5, *XIX*), of which we have seen the rudiments through the transparent integument in the previous stage. Both branches of these appendages are developed as two oval plates, of which the outer is two thirds the length of the telson, the inner about one third. The larger plate is fringed with fine setæ on its inner, and on the hinder portion of its outer, border. The telson itself, as before said, is much narrower than before, and is separated by a suture from the sixth abdominal segment. Its hind margin now bears but twelve long setæ, the external one on each side having disappeared.

On the lower side of the thorax, between the bases of the swimming-feet, is a good deal of green pigment beautifully arranged in dendritic figures. Other parts of the body also are rendered conspicuous by spots of red, green, and yellow.

Length, 3.5 mm.

Fourth Larval Stage (Pl. II. Figs. 10 – 15 ; Pl. III. Figs. 1 – 3). — At

the next moult the larva assumes the form represented on Plate II. Fig. 10. Considerable structural advance appears in the antennæ, in the acquisition of another pair of swimming-feet, and the rudiments of all the abdominal appendages.

The carapace now has two spines pointing forward in the median dorsal line. The inferior side of each of these is armed with minute, recurved teeth. The successive unfolding of the swimming-feet from before backwards has been accompanied by a lengthening of the carapace in a posterior direction, so that when the last pair has appeared the bases of the whole line of limbs are covered by the branchiostegite.

The rudimentary inner flagellum of the first pair of antennæ (Pl. II. Fig. 11, *ri*) has increased a little in size, but is still composed of one segment. The inner branch of the second antenna (Pl. II. Fig. 12, *ri*) has gained in length in relation to the outer branch, and is now divided into three segments, of which the first and second are short and thick, the third long and style-shaped.

The sixth pair of biramous natatory appendages (the third pair of Decapodal legs) are now present, and the first sign of the formation of chelæ on the two antecedent pairs appears in the slight production of the antero-internal angle of the penultimate segment of their inner branches. As will be seen further on, this angle becomes produced more and more until at last it forms a thumb opposable to the dactylus. The first two pairs of swimming-feet are now quite small compared with the following pairs, and begin to assume the proper function of maxillipeds. Behind the sixth pair of swimming-feet are the rudiments of the following two pairs of thoracic appendages (Pl. III. Fig. 1, *XII*, *XIII*; Figs. 2, 3). The seventh pair (Fig. 2) are double; the eighth pair, or hindmost thoracic appendages (Fig. 3), simple, sac-like structures. They are bent forward underneath the thorax, and concealed by the appendages in front of them.

The appendages of the abdominal segments from the first to the fifth inclusive are now for the first time seen (Pl. II. Fig. 10, *XIV*–*XVIII*). They are simple buds from the lower face of the abdomen, and in a side view they are almost concealed by the pleuræ. The appendages of the sixth segment of the abdomen (Pl. II. Fig. 15) have now acquired a shape nearly like those of the adult prawn. The inner plate (*ri*) is almost as long as the outer (*re*), and both are clearly defined from one another and from the basal segment (protopodite). Both plates are provided with long and delicately fringed setæ arranged as represented in the figure.

The posterior border of the telson (Pl. II. Fig. 15, *t*) now but slightly exceeds the anterior end in width. It is deeply concave, and furnished with but eight long setæ. The spaces between the long setæ contain two very small setæ; those in the median interspace are longer than the rest.

It appears from my notes that on the 8th of August, 1878, a specimen in the stage described above as the third moulted in one of my aquaria, and then appeared in a shape differing in one respect from that which I have just described as the fourth larval stage. Besides the acquirement of the sixth pair of swimming-feet, the *seventh* pair were developed in this specimen as biramose, clearly segmented, setiferous appendages (Pl. II. Fig. 14), but very small in size compared with the sixth and preceding pairs. The last pair of thoracic limbs were simple, sac-like organs. This early development of the seventh pair of swimming-feet I regard as premature; in the normal course of development it is anticipated by the eighth pair, as will appear presently.*

Fifth Larval Stage (Pl. III. Figs. 4–13).—This stage was reared from the fourth stage in one of my jars. The most important structural advance upon the preceding stage consists in the full development of the hindmost pair of thoracic appendages. The flagellum of the second pair of antennæ has increased in length, and the long terminal segment shows a faint indication of division into four segments. There is a short spine (Fig. 4, *II*, *sp.*) on the outer side of the distal end of the posterior antennæ, which becomes larger in later stages of the development. This spine is more highly developed in the larvæ of *Paguridae*, and represents the enormously developed spinous process of the second pair of antennæ so frequently found in the zoëæ of the *Brachyura*. From the exuviae of one individual I obtained for the first time the complete structure of the mandible (Fig. 7, *III*). It is composed of two branches, as in the adult, but the anterior branch, instead of presenting a molar crown, as in the full-grown animal (Pl. IV. Fig. 19), ends in multidenticulate incisor edge. This branch is concealed beneath the fleshy labrum, and hence escaped detection in the earlier stages.

The chela of the fourth pair of swimming-feet is more perfectly formed than before, the penultimate segment being much enlarged, with its internal angle produced as far as the middle of the terminal segment

* I find among some larvæ which I preserved in alcohol one specimen with five pairs of natatory appendages (in this agreeing with the third stage above described), but in every other respect agreeing with the fourth stage. Behind the last pair of swimming-feet are the double, sac-like rudiments of the two following pairs. Length, 4 mm.

(Fig. 4, *IX*). The chela of the following pair of appendages is not so much developed as yet. The penultimate pair of thoracic legs (Fig. 4, *XII*) are still rudimentary, unsegmented, double sacs.

The last pair of thoracic legs, however, are fully developed as long, simple, 5- or 6-jointed appendages (Fig. 4, *XIII*). This pair alone of all the thoracic appendages are destitute of external branches from their very earliest appearance. They are generally borne curved forward under the sternum, in which position the distal segment (which bears a long, coarse terminal bristle) reaches forward to the maxillæ. The inner branches of the double thoracic legs are in the same way tucked under the breast when the animal swims.

The appendages of the first, second, third, fourth, and fifth abdominal somites have gained in size. The second, third, and fourth pairs (Fig. 11) present a little lobe on the inner side (*ri*), which is the beginning of the formation of the inner branch.

The telson (Fig. 13, *t*) is at this stage narrower behind than in front. Its hind margin is armed with eight setæ.

Length, 5.5 mm.

Sixth Larval Stage (Pl. III. Figs. 14 – 16 ; Pl. IV. Figs. 1–8). — The larva issues from the next moult provided for the first time with all the swimming-legs. The sacs which represented the penultimate pair previous to the moult have set free a pair of two-branched limbs similar to those in front, but with quite small external branches. This is the nearest approach to a true *Mysis*-stage which appears in the development. It differs from the Schizopod in the lack of the outer branch of the last thoracic feet.

Besides the unfolding of the penultimate pair of thoracic appendages, there is but little change from the phase immediately before the last moult. The inner branch of the second antennæ (Pl. III. Fig. 14, *ri*) is clearly divided into six or seven segments. The chelæ (Pl. III. Figs. 15, 16) are more perfectly formed. The two lobes of the abdominal appendages (Pl. III. Fig. 17) have become enlarged and marked off by constriction from the basal portion of the limb. The posterior border of the telson (Pl. III. Fig. 18, *t*) is cut into a shallow notch, and bears three pairs of long setæ. In the interval between the central pair are two much smaller setæ.

Length from tip of the rostrum to end of the telson, 6 mm.

I succeeded in rearing this stage through two successive moults. The resulting forms differed so little from the one just noticed (no new structures appearing), that I have included all three under the name of *sixth larval stage*.

After the first moult the larva had the form represented on Plate IV. Fig. 1. The general shape is very much like the adult, but all the feet except the last pair are provided with an outer swimming branch. The armature of the carapace is now as follows: two large spines in the median dorsal line, the anterior of which lies over the base of the eye-stalks; one on each side near the anterior margin, on a level with the eye-stalks; all of these are directed forward and furnished with minute recurved teeth on their lower sides; in addition to these there is a small antennal spine on each side of the carapace on the anterior margin on a level with the base of the second pair of antennæ, and a very minute spine at the antero-inferior angle of the carapace just below the antennal spine; this is probably the branchiostegal spine in the adult. The rostrum is furnished with hairs on its upper edge in front of the anterior dorsal spine. The peduncle of the first pair of antennæ is now divided into three segments; both the inner and outer branches have increased in length. The flagellum of the second pair of antennæ (Fig. 2, *r i*) exceeds the scale in length, and its distal half is divided up into six or seven segments. The first pair of maxillipeds (Fig. 1, *VI*) are very small compared with the Decapodal legs; the second and third pairs increase in length successively. The chelipeds (*IX, X*) are terminated by a perfect claw, in which the process of the penultimate segment is equal in length to the dactylus; both dactylus and the opponent process are furnished with a few plumose setæ. The exopod of the penultimate thoracic limbs has now attained a size equal to that of the limbs in front. The appendages of the abdomen (*XIV-XVIII*) are much larger than before the last moult; a small projection from the inner border of the internal rami of the second to the fifth pairs (Fig. 5, *s*) is the beginning of the slender stylet in the adult (Fig. 26, *s*); both branches are now furnished with long plumose hairs; the inner branch of the first pair (Fig. 4, *r i*) is rudimentary.

One individual of the form just noticed died during the process of exuviation in one of my aquaria. It sufficed to show that the larva after the moult differed in no important regard from the antecedent form. The tooth on the outside margin of the outer blade of the swimmerets, which is so conspicuous in the adult (Fig. 29), is beginning to appear (Fig. 8). The telson is still armed with three pairs of long bristles (Fig. 8); within the inner pair are two of very minute size.

Length, 8 mm.

I failed to rear any of the larvæ in confinement beyond this stage. The next form in the series which I have met with is the one repre-

sented by Fig. 15 of Plate IV. This was frequently taken in the hand-net free-swimming at the surface of the sea. Although but eight millimetres long, the larva has acquired the form and almost every character of the adult prawn.

Among the drawings of Crustacean larvæ made by Mr. Agassiz at Newport, which he has generously placed at my disposal, are some details of the structure of a larval stage of *Palæmonetes vulgaris* which happily fills in some measure the gap between the sixth larval stage and the adult form. This phase in the development I will designate as the

Seventh Larval Stage (Pl. IV. Figs. 9–14).—There is no sketch of the general form of this stage among Mr. Agassiz's drawings. The rostrum (Pl. IV. Fig. 9) is long and scymitar-shaped, with six teeth above and two below. Between the teeth of the dorsal side are hairs, as in the adult. The anterior third of the rostrum is destitute of teeth. The carapace is armed, moreover, with an antennal and a minute branchiostegal spine on each side. The supra-orbital spine is reduced to a mere rudiment.

The natatory branch of the maxillipeds and legs (Pl. IV. Figs. 10, 11, 13, *re*) is reduced to a short style composed of one segment. In this we see an interesting transition state between the Schizopod and the Decapod leg. The inner branches of the first and second pair of maxillipeds have also diminished, and now consist of one and two segments respectively (Pl. IV. Figs. 10, 11). The segments of the internal branches of the chelipeds and ambulatory appendages are clearly seven in number. The last pair of thoracic legs (Pl. IV. Fig. 14) is of course without the external styliform appendage.

The antennæ, swimmerets, and telson are not represented in Mr. Agassiz's figures, nor is the natural size indicated.

Specimens in the sixth larval stage may measure eight millimetres from the tip of the rostrum to the tip of the telson. This is as long as specimens which have attained the adult form, such as is represented by Figure 15 of Plate IV. Hence I infer that but few stages intervene. It is highly probable, however, that the larva suffers one or two moults between the seventh stage and the attainment of the shape of the adult prawn.

Early Stage of the Adult Form (Pl. IV. Fig. 15).—Although measuring only eight millimetres from the tip of the rostrum to the end of the telson, the prawn has now the true Decapod structure; although still a free-swimming surface-dweller. Every trace of the external swimming-branches of the five pairs of legs has vanished, and the structure is in

almost every detail like that of the adult prawn, parts of which are represented on Plate IV. Figs. 16 – 31. The integument, however, is much thinner and more transparent, the legs are longer, and the external plate of the swimmerets is not divided by a transverse suture. The rostrum (Pl. IV. Fig. 32) is nearly as long as the portion of the carapace behind it. Viewed in profile, it increases in depth from the root to beyond the middle, thence tapers with a gentle upward curve to a fine point at the tip. It is armed above with seven, below with three, teeth. The second tooth, counting from the base, lies over the proximal end of the eye-stalks. They are all directed forward, and in the intervals between them are two or three hairs.

As the prawn develops, new teeth are added between the older ones and the tip of the rostrum. In a specimen which measures 9 mm. in length, the dental formula is $\frac{3}{3}$ (Pl. IV. Fig. 33). In the mature prawn the number of teeth on the rostrum is commonly nine above and four below (Pl. IV. Fig. 30), but is subject to great variation. Thus, I find on looking over a large series of specimens measuring from 28 mm. to 42 mm. in length, the following formulæ for the rostral teeth :

$$\frac{11}{4}, \frac{10}{4}, \frac{10}{3}, \frac{9}{4}, \frac{9}{3}, \frac{9}{2}, \frac{8}{5}, \frac{8}{3}, \frac{8}{2}, \frac{7}{2}, \frac{6}{3}, \frac{6}{2}.$$

Hence will appear the folly of those zoölogists who have taken the form of the rostrum as a means for distinguishing species in the group of *Caridea*. The carapace is provided, moreover, with an antennal and a branchiostegal spine on the fore margin of each side. There is now no trace left of the large supra-orbital spine which was so conspicuous in most of the larval stages. The pterygostomial angle is rounded off as in the full-grown individuals. The pleuræ of the fifth abdominal segment extend backward over the following somite, but are not drawn out into a long spine as in the larval stages.

The telson has the same form and armature as in full-grown specimens. It tapers posteriorly to a very narrow hind margin which is produced in the middle in the form of a stout tooth. From the lower face of this median tooth issue a pair of long, plumose setæ. On each side of the median tooth is a long spine, which is articulated with the telson, and outside of these is a short spine, similarly articulated with the external angle of the posterior border of the telson. The dorsal surface of the telson has four small spines arranged as in the mature prawn.

The third flagellum of the first pair of antennæ is now present as a short, two-jointed appendage tipped by fine hairs (Pl. IV. Fig. 15, *r e'*). It does not issue from the peduncle of the antennule, but from the inner

side of the third segment of the primary (external) flagellum. In full-sized individuals the free portion of the tertiary flagellum may have as many as thirteen or fourteen segments, and the distance between its base and the base of the primary flagellum may contain as many as eight segments.

The second pair of antennæ are about as long as the body. The mandibles (Fig. 18) are two-branched. One of the branches is terminated by a molar surface (Fig. 19), the other by *three* incisor teeth in the right mandible (Fig. 18), *four* in the left (Fig. 20).

The first pair of maxillæ (Fig. 21) consist of two lobes (*a*, *b*), which are fringed with setæ on their inner borders, and a palpus (*r i*) bilobed at its free end.

The second pair of maxillæ (Fig. 22) are composed of a bifid inner plate (protognath, *a*) fringed on its internal border with setæ, a middle piece (endognath, *r i*) composed of one segment, and a large ear-shaped scaphognathite (exognath, *r e*), whose margin is beset with long and delicate hairs.

The first pair of maxillipeds (Fig. 23) have a very complicated structure. The inner, prehensile portion consists of two thin, foliaceous lobes (*a*, *b*), of which the distal (*b'*) is the larger. The edges of both are provided with setæ. The other parts of the organ are probably tactile and respiratory in their function, and consist of a tongue-shaped middle piece (*r i*); an external, large, oval plate which gives off a long palpiiform appendage (*r e*); and two small oval plates (*e p*, *e p'*) at the base of the larger external plate. The inner margin of the latter, and the distal third of its appendage, are fringed with fine setæ. The two smaller external plates (*e p*, *e p'*) are of a soft consistency, and very probably serve in a measure to ærate the blood.

The penultimate segment of the endognath of the second pair of maxillipeds (Fig. 24) is produced on the inner side into a large lobe, to the distal margin of which the terminal segment is articulated. The two segments together thus form a broad oval blade, which is reflected upon the inner side of the antecedent segments, and lined with setæ on its oral border. The exognath (*r e*) is long and slender. At the base of the limb, on the external side, are a small roundish epignath (*e p*) and a small but well-formed gill (*b r*).

The third pair of maxillipeds (Fig. 16) are composed of the same parts as the second maxillipeds, but the inner branch (*r i*) is pediform and twice the length of the external branch (*r e*).

The structure of the following thoracic appendages is so well known

that a detailed description of them would be superfluous. In specimens 8 mm. or 9 mm. long the transverse suture of the exopod of the swimmerets (Fig. 15, *XIX, re*) has not yet appeared. As in full-grown individuals, the inner side of the tip of the styliform appendage of the preceding abdominal members (Fig. 26, *s*) is furnished with microscopic curled hairs (Fig. 27), whose function I cannot imagine. They occur in both sexes. The internal branch of the second pair of abdominal members in mature male specimens presents a second slender inner appendage (Fig. 28, *s'*) fringed with hairs on its outer margin. The small endopod of the first pair of abdominal appendages, moreover, is differently shaped in the two sexes. In the male, the distal third widens and trends slightly inward; on the inner margin, near the base, are some long setæ; the distal portion bears short, plumous setæ. In the female, the endopod narrows gradually from its root to the tip, and is fringed at the end and along the internal border by long feather-like hairs.

In the above-described series of larval forms I have never obtained the third stage directly from the second, but with this exception I have actually reared in confinement each successive stage from its predecessor, from the first to the sixth inclusive.

The only larva known to me on this coast liable to be confounded with *Palæmonetes* is that of *Virbius zostericola* Smith. In specimens 6.5 mm. long, still in the Schizopod condition, the carpus of the second pair of feet is already tri-articulate, and the setæ of the telson, form of the antennal scale, and other characters serve to distinguish it from the young *Palæmonetes*.

It appears, from what precedes, that *Palæmonetes* issues from the egg in the zoëa-form, i. e. provided with a pair of compound eyes, two pairs of antennæ, two pairs of maxillæ, and three pairs of swimming-feet, the future maxillipeds. Behind the third pair of swimming-feet are the rudiments of the following two pairs of appendages in the shape of double sac-like structures. No gills exist, the aëration of the blood being accomplished through the general integument, and especially under the sides of the carapace, by means of a current of water maintained, as in the gill-bearing adult, by the constant motion of the broad external plate of the second maxillæ. The abdomen is wholly devoid of appendages, and the telson is not clearly marked off from the sixth abdominal segment.

As development proceeds, the rest of the thoracic legs are unfolded in succession from before backward. The only break in the regular order of succession is caused by the unfolding of the last pair earlier than the

penultimate. All the thoracic appendages, excepting the last pair, are furnished with external natatory branches. By subsequent moults the natatory branches are reduced in size, and finally disappear altogether. During the evolution of the thoracic limbs, the abdominal appendages make their appearance, first the posterior pair (which develop within the caudal plate or telson), then the anterior pairs.

The different forms which the individual assumes during its development are in this case the result of gradual growth, each successive moult developing a form which shows but a slight advance upon the one immediately preceding it. It is, nevertheless, a true metamorphosis, involving the acquirement of new structures, the atrophy of others, and change of function of still others; the structural difference between the young larva and the adult prawn being much greater than in insects with a so-called incomplete metamorphosis, like the *Orthoptera*.

I am inclined to think there is error in many of the observations recorded of consecutive stages in the development of the *Macroura* captured with the hand-net or tow-net. In most of these cases the great difference in form between the specimens warrants the assumption that intervening stages are missing. Consecutive stages which I have actually reared in confinement often do not differ appreciably from one another in size, so that one cannot be sure from the relative size alone of his larvæ that links are not wanting in his chain of forms.

Excepting the statement of Agassiz that *Palæmonetes vulgaris* hatches from the egg as a *Cuma*,* the only notice of the developmental history of this species, with which I am acquainted, is the short description of the first larval stage, by S. I. Smith, already cited.†

But few observations have been made upon the development of the European species of *Palæmon*, which is somewhat strange when one considers how common some of them are.

The first naturalist who published anything concerning the development of the genus was Rathke, who made some observations in 1833 upon the growth of the embryo within the egg of *Palæmon adspersus* Rathke (= *P. rectirostris* Zaddach, according to Heller),‡ and *Palæmon squilla*.§ These observations are so full of error that they have only an historical interest. Prejudiced by his studies upon the devel-

* Amer. Jour. Sci. and Arts, 2d Series, Vol. XIII. p. 426. 1852.

† *Supra*, p. 304.

‡ Die Crustaceen des südlichen Europa, p. 270. 1863.

§ Ueber die Entwicklung der Decapoden. Müller's Archiv, 1836, pp. 187-192. Zur Morphologie, Reisebemerkungen aus Taurien, pp. 81-93, 179-184, Pl. IV. Figs. 1-10. 1837.

opment of *Astacus*, Rathke came to the conclusion that the prawn too acquires, while still within the egg, all the external parts (excepting the sexual organs) which are found in the adult, and that it is subject to no greater structural changes after leaving the egg than a bird is! After further researches upon the development of Decapods, Rathke acknowledged his error, and his handsome tribute to J. V. Thompson, in this connection, is a notable example of candor.*

The changes which the young suffers after leaving the egg were first observed by J. V. Thompson. In the summer of 1828 he obtained the first stage of the larva by hatching the eggs of *Palæmon serratus*, and in a paper published in 1836 † gave a rough figure of this, together with two older larval prawns which he supposes to belong to the same species, although they were captured free-swimming.

How much allowance must be made for inaccuracy in Thompson's figures it is hard to say. The first stage is represented with but two pairs of cleft members; in the second stage the larva has acquired an additional pair of swimming-feet, the sixth pair of abdominal appendages are present, and form with the telson a terminal fin about like that in our third larval stage. There is yet no dorsal spine on the carapace, and the first pair of antennæ are still simple.

The third stage apparently represents a phase somewhat more advanced than our sixth stage. The carapace is now armed with three spines on the median dorsal line, and a supra-orbital spine on each side. All of the appendages are now present, the chelæ are well formed, and all of the thoracic members, not excepting the posterior pair, are furnished with a natatory branch. The flagellum of the second pair of antennæ is in the condition of the adult, being divided into an indefinite number of annuli. In other respects the young prawn agrees pretty well with the sixth stage of *Palæmonetes*.

The most complete account of the larval stages of *Palæmon* up to the present time is that of Captain DuCane, published in 1839, in the second

* Zur Entwicklungsgeschichte der Dekapoden. Arch. f. Naturgesch., 1840, I. p. 248.

Beiträge zur vergleichenden Anatomie und Physiologie, Reisebemerkungen aus Skandinavien, p. 46. Neueste Schriften der Naturforsch. Gesell. in Danzig, Vol. III. 1842.

† Memoir on the Metamorphosis in the Macrouræ or Long-tailed Crustacea, exemplified in the Prawn (*Palæmon serratus*). Edinburgh New Philosoph. Jour., Vol. XXI. pp. 221-223, Pl. I. 1836. A short notice of this paper appears in the "Abstracts of the Papers printed in the Philosophical Trans. of the Royal Soc.," Vol. III. p. 371. 1836.

volume of the *Annals of Natural History*.* In this communication the author gives a brief description and rude figures of four larval stages of the ditch prawn, *Palæmon variabilis* [*Palæmonetes varians* Heller?]. The earliest form represented is that which the larva assumes immediately after exclusion from the egg. The first pair of antennæ are portrayed with *two* terminal, one-segmented branches, a condition not seen in any other figures of the first larval stage of *Palæmon*. As in Thompson's figure of the same stage, only two pairs of swimming-feet are represented. Behind them are the rudiments of the true legs in the shape of three pairs of small, simple, two-jointed processes. The number of abdominal segments is plainly exaggerated.

In the second stage, "ascertained by observing the moult of the former," the carapace is armed with a dorsal spine at the base of the rostrum, and all the thoracic legs are present! The posterior pair are destitute of the natatory branches; the chelæ are developed. It is noteworthy that the author expressly states that the abdominal appendages have begun to appear, excepting the last pair. If this be correct, it is certainly an exceptional order of development among the *Macroura*. Commonly in this group the posterior pair appear before the other abdominal appendages.

In the third stage, "also ascertained by witnessing the moult," the carapace has two dorsal and supra-orbital spines, and the posterior pair of abdominal limbs have appeared.

The fourth stage was not obtained directly from the third by observing the moult. The larva now has three dorsal spines, and, excepting the want of external branches to the last pair of thoracic legs, agrees well with Thompson's third stage. The next moult brought it to the condition of the adult prawn.

It is obvious from the above account that the number of forms passed through by the larva before reaching the adult shape is much smaller than in the case of *Palæmonetes vulgaris*, unless there is error in the observations of DuCane.

The next observation bearing upon the development of *Palæmon* is found in Fritz Müller's "Für Darwin."† It consists of a brief description, accompanied by a wood-cut, of what seems to be the first larval stage.

The researches of Bobretzky upon the development of *Palæmon*, published in the Russian language, at Kief, in 1873,‡ have already been

* Letter from Captain DuCane, R. N., . . . on the subject of the Metamorphosis of *Crustacea*, *Ann. Nat. Hist.*, Vol. II. pp. 178-181, Pl. VI, VII. 1839.

† Für Darwin. 1864. English Trans. by W. S. Dallas, p. 55, Fig. 27. 1869.

‡ Zapiski Kiefs. Obshtshest. Yestestvoisпитatelyci, Vol. III. pp. 186-252, Pl. IV-VI. 1873. Hofmann und Schwalbe's "Jahresberichte," Vol. II. pp. 317, 318. 1875.

referred to. They relate almost exclusively to the intra-oval development, and for this part of the history are the completest yet made, the microtome having been used for getting sections of the egg in the different stages of its growth.

In 1874 Anton Stuxberg published an incomplete description of the embryo before hatching, and of the first larval stage of *Palæmon squilla*.*

In an abstract of a paper on the development of *Crustacea*, by Spence Bate, in the Proceedings of the Royal Society of London, 1876,† (the full paper has never been published to my knowledge), the author makes the surprising statement, that in the embryo of *Palæmon*, etc., the anterior of the three earliest formed pairs of lobes (nauplius-appendages) develop directly into the eyes, while the posterior two pairs are cast off with an early moult and replaced by the permanent antennæ!

CAMBRIDGE, June 1, 1879.

* Karcinologiska iakttagelser. Öfversigt af Kongl. Vetenskaps-Akad. Forhandl., 1873, No. 9, pp. 16 - 19. 1874.

† "On the Development of the Crustacean Embryo, and the Variations of Form exhibited in the Larvæ of 38 Genera of Podophthalmia." Proc. Royal Soc. London, Vol. XXIV. pp. 375 - 379. 1876.

I believe I have not misrepresented Spence Bate here, but will quote in full:—"The author has taken this opportunity of making a close examination into the earlier stages in the development of the embryo, and comparing the progress within the ovum of some of the larvæ that arrive at or near maturity before being hatched, with those of the larval forms that are hatched in a more immature condition; and he states that, as soon as the protoplasm assumes anything like a definite plan, distinct lobes, corresponding in position with those of the several appendages in the *Nauplius*, together with an embryonic or ocular spot, are present; that in the *Nauplius* forms they exist as deciduous appendages only, and are soon cast aside and replaced by others more adapted to the wants of the adult existence.

"In the embryos of other *Crustacea* the anterior pair of lobes enlarge in size with little alteration of form, while the posterior two pairs are developed into appendages that have but a deciduous value, since they never fulfil the office of permanent organs, and are generally cast off with an early moult.

"This is observable within the ovum in *Palæmon*, *Crangon*, etc., and also in the marsupial embryo of *Mysis* after it has quitted the ovum.

"The relation of these parts to the permanent organs the author has closely traced, and believes that he has demonstrated that the three pairs of mobile appendages in the cirripedal or *Nauplius* form of larva homologize with the eyes and two pairs of antennæ, and not with the antennæ and mandibles, as stated by Fritz Müller, Anton Dohrn, and others."

EXPLANATION OF THE PLATES.

The appendages, from the first to the last pair, are indicated throughout by consecutive Roman numerals. They correspond with the appendages of the adult as follows :—

<i>I</i> , first antenna.	<i>XI</i> , third pair of legs.
<i>II</i> , second antenna.	<i>XII</i> , fourth " "
<i>III</i> , mandible.	<i>XIII</i> , fifth " "
<i>IV</i> , first maxilla.	<i>XIV</i> , first pair of abdominal appen- [dages.
<i>V</i> , second maxilla.	<i>XV</i> , second " " "
<i>VI</i> , first maxilliped.	<i>XVI</i> , third " " "
<i>VII</i> , second maxilliped.	<i>XVII</i> , fourth " " "
<i>VIII</i> , third maxilliped.	<i>XVIII</i> , fifth " " "
<i>IX</i> , first pair of legs (cheliferous).	<i>XIX</i> , sixth " " "
<i>X</i> , second " " "	

The Arabic numerals denote the somites of the abdomen.

<i>ab</i> , abdomen.	<i>ng</i> , nerve-ganglion.
<i>ar</i> , artery.	<i>oc</i> , compound eye.
<i>cd</i> , cephalic disk.	<i>ocl</i> , ocellus.
<i>cp</i> , carapace.	<i>re</i> , external branch of appendages.
<i>ht</i> , heart.	<i>ri</i> , internal " "
<i>in</i> , intestine.	<i>rs</i> , rostrum.
<i>lb</i> , labrum.	<i>t</i> , telson.
<i>m</i> , mouth.	<i>vt</i> , yelk.

Plate I.

- Fig. 1. Egg with four segments produced by an equatorial and a meridional cleavage. Each segment contains a nucleolated nucleus (*n*), around which delicate lines of protoplasm are disposed like rays.
- Fig. 2. Egg with sixteen cleavage spheres.
- Fig. 3. The surface of the yelk is now divided into small polygonal blastomeres. *g*, orifice of gastrula-cavity.
- Fig. 4. Profile view of the embryo, four days after the gastrula-stage. The appendages have appeared from the first to the sixth pair. Excepting the first pair, they are bilobed or double.

- Fig. 5. Embryo three days later, from the ventral side. The rudiments of the appendages are now seen from the first to the eighth pair (third pair of maxillipeds).
- Fig. 6. Egg with the enclosed embryo further advanced, viewed from the side.
- Fig. 7. The same, from above.
- Fig. 8. Older embryo, from the ventral side.
- Fig. 9. Still older embryo, from the side.
- Fig. 10. Egg as it appears a few hours before hatching. *p*, the gluey secretion which fixes the egg to the abdominal appendages of the mother.
- Fig. 11. Embryo extracted from the egg just before hatching. The rostrum (*rs*) lies bent under the head. The appendages of the right side are spread out in order that their structure may be seen.
- Fig. 12. Second maxilla of the same.
- Fig. 13. Appendages of the ninth and tenth pairs of the same (representing the two pairs of chelipeds in the adult).
- Fig. 14. First larval stage, viewed from below. *an*, anus.
- Fig. 15. The same; antenna of the first pair.
- Fig. 16. The same; antenna of the second pair. The inner branch (*ri*) develops into the flagellum; the outer branch (*re*) into the scale.
- Fig. 17. The same; parts about the mouth.
- Fig. 18. The same; two adjacent long setæ of the telson, with four very minute setæ in the interspace.

Plate II.

- Fig. 1. First larval stage, viewed from the side.
- Fig. 2. Second larval stage, viewed from the side.
- Fig. 3. The same, viewed from above.
- Fig. 4. The same; oral and thoracic appendages.
- Fig. 5. Third larval stage, from below.
- Fig. 6. The same; anterior part of the carapace, viewed from the side. *x*, dorsal spine. *y*, supra-orbital spine. *z*, antennal spine.
- Fig. 7. The same; posterior border of the labrum.
- Fig. 8. The same; first maxilla. *a*, inner lobe. *b*, outer lobe. *ri*, palpus.
- Fig. 9. The same; second maxilla. Only a small part of the scaphognathite (*re*) is represented.
- Fig. 10. Fourth larval stage, side view.
- Fig. 11. The same; first antenna. *ri* and *re*, rudimentary flagella.
- Fig. 12. The same; second antenna.
- Fig. 13. The same. *lb*, labrum. *m*, mouth. *III*, mandible. *ms*, metastoma. *IV*, first maxilla. *a*, *b*, *ri*, as in Fig. 8.
- Fig. 14. The same; abnormally developed appendage of the penultimate thoracic pair.
- Fig. 15. The same; telson and swimmeret.

Plate III.

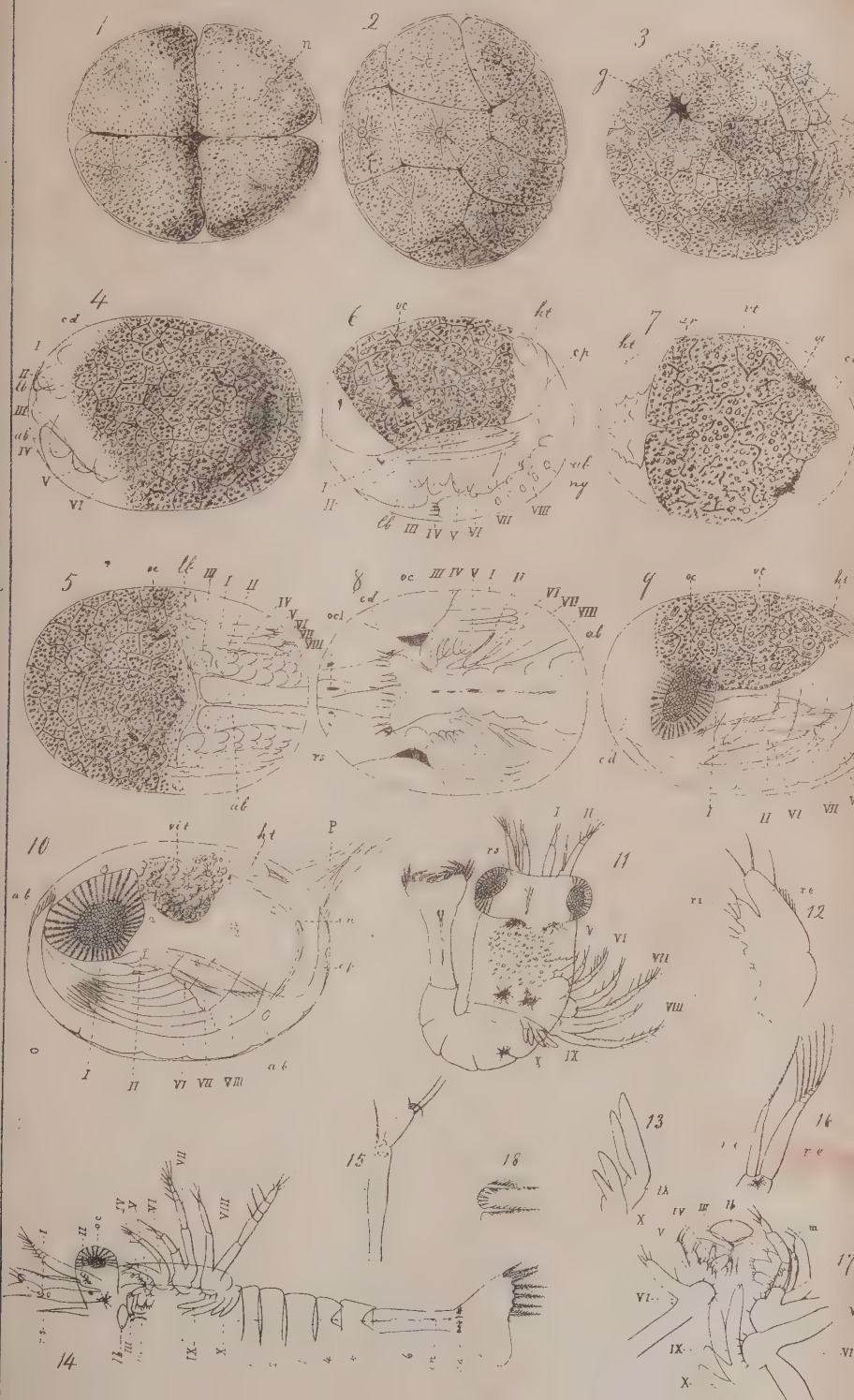
- Fig. 1. Fourth larval stage ; cephalo-thorax, from below.
 Fig. 2. The same ; penultimate thoracic appendage.
 Fig. 3. The same ; last thoracic appendage.
 Fig. 4. Fifth larval stage ; cephalo-thorax viewed from below. *sp*, spinous process of second pair of antennæ.
 Fig. 5. The same ; anterior part of the carapace.
 Fig. 6. The same ; fifth abdominal somite, viewed from the side.
 Fig. 7. The same ; labrum (*lb*) and mandibles (*III*).
 Fig. 8. The same ; second maxilla.
 Fig. 9. The same ; natatory branch of the tenth pair of appendages.
 Fig. 10. The same ; abdominal appendage of the first pair.
 Fig. 11. The same ; abdominal appendage of the second pair (those of the third and fourth pairs have the same form).
 Fig. 12. The same ; abdominal appendage of the fifth pair.
 Fig. 13. The same ; telson and swimmerets.
 Fig. 14. Sixth larval stage, one moult after the fifth larval stage ; antenna of the second pair ; *sp*, spinous process.
 Fig. 15. The same ; first cheliped.
 Fig. 16. The same ; second cheliped.
 Fig. 17. The same ; one of the abdominal appendages.
 Fig. 18. The same ; telson and swimmerets.

Plate IV.

[NOTE. Figs. 9-14 are from drawings by Mr. A. Agassiz.]

- Fig. 1. Sixth larval stage, two moults after the fifth larval stage, lateral view.
 Fig. 2. The same ; second antenna ; *sp*, spinous process.
 Fig. 3. The same ; cheliped with its external, natatory branch (*re*).
 Fig. 4. The same ; first abdominal appendage.
 Fig. 5. The same ; second abdominal appendage.
 Fig. 6. The same ; posterior margin of the telson.
 Fig. 7. Sixth larval stage, three moults after the fifth larval stage ; anterior end of first antenna.
 Fig. 8. The same ; telson and swimmeret.
 Fig. 9. Seventh larval stage ; rostrum and eye.
 Fig. 10. The same ; second maxilliped.
 Fig. 11. The same ; third maxilliped.
 Fig. 12. The same ; chela.
 Fig. 13. The same ; rudimentary external branch (*re*) of thoracic legs.
 Fig. 14. The same ; posterior thoracic leg.
 Fig. 15. Young prawn, 8 mm. long, which has acquired most of the characters of the adult.
 Fig. 16. Adult ; third maxilliped.
 Fig. 17. The same ; scale of second antenna.

- Fig. 18. The same; right mandible.
 Fig. 19. The same; molar crown of mandible.
 Fig. 20. The same; end of incisor branch of left mandible.
 Fig. 21. The same; first maxilla. *a*, inner lobe. *b*, outer lobe. *ri*, palpus. *ep*, epignath.
 Fig. 22. The same; second maxilla. *a*, *b*, lobes of protognath. *ri*, *ramus internus*. *re*, *ramus externus*, or scaphognathite.
 Fig. 23. The same; first maxilliped. Letters as before.
 Fig. 24. The same; second maxilliped. *br*, gill.
 Fig. 25. The same; first abdominal appendage.
 Fig. 26. The same; fourth abdominal appendage. *s*, appendage on inner side of the internal branch.
 Fig. 27. The same; tip of the styliform appendage (*s* of the preceding figure) of abdominal limbs, highly magnified to show the curled hairs.
 Fig. 28. The same; inner branch of second abdominal appendages in the male, bearing *two* slender appendages, *s* and *s'*.
 Fig. 29. The same; telson and swimmerets.
 Fig. 30. The same; carapace.
 Fig. 31. Rostrum of another adult specimen.
 Fig. 32. Rostrum of the specimen represented by Fig. 15.
 Fig. 33. Rostrum of an individual 9 mm. long.



- Fig. 5. Embryo three days later, from the ventral side. The rudiments of the appendages are now seen from the first to the eighth pair (third pair of maxillipeds).
- Fig. 6. Egg with the enclosed embryo further advanced, viewed from the side.
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- Fig. 15. The same; telson and swimmeret.

Plate III.

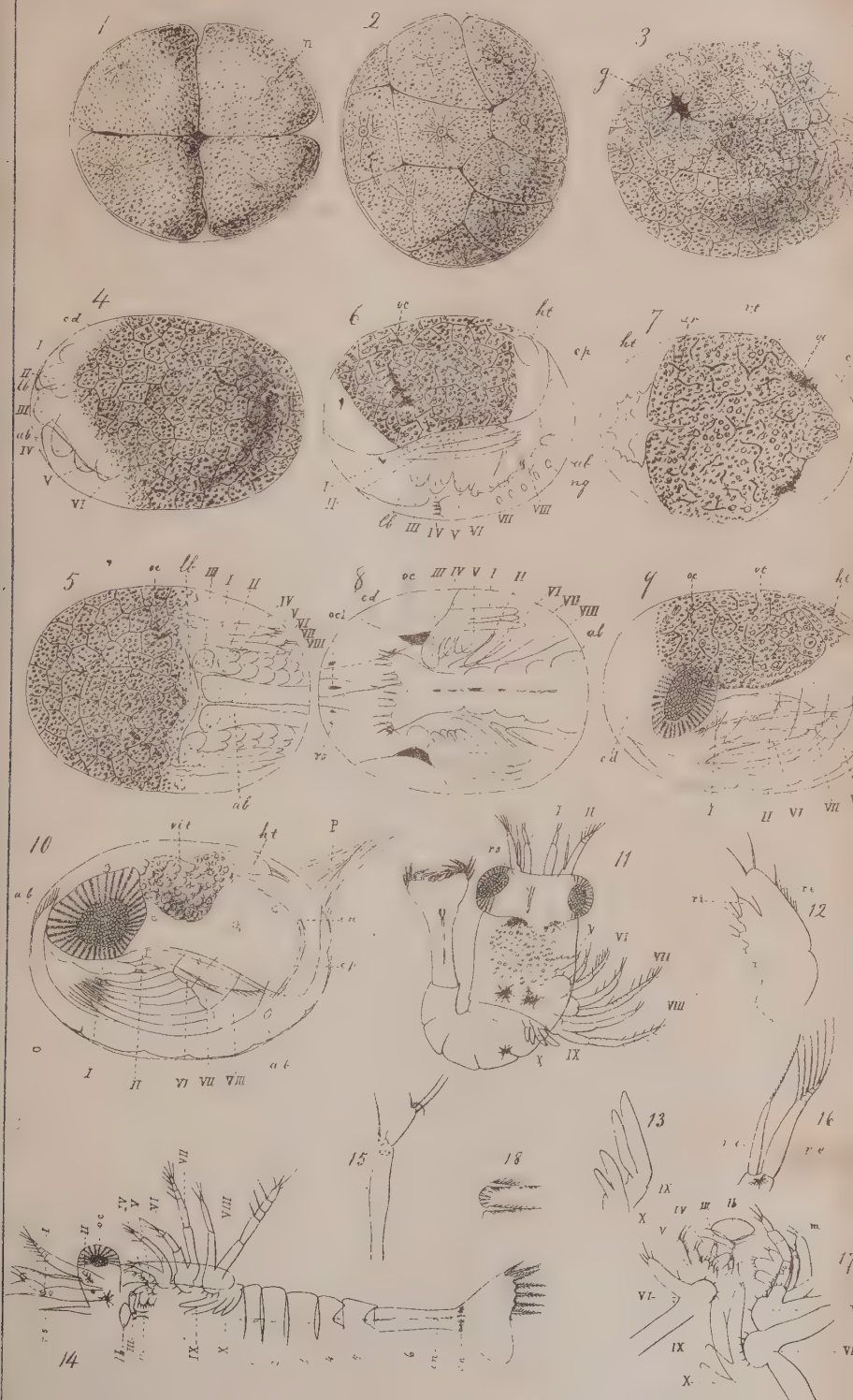
- Fig. 1. Fourth larval stage ; cephalo-thorax, from below.
 Fig. 2. The same ; penultimate thoracic appendage.
 Fig. 3. The same ; last thoracic appendage.
 Fig. 4. Fifth larval stage ; cephalo-thorax viewed from below. *sp*, spinous process of second pair of antennæ.
 Fig. 5. The same ; anterior part of the carapace.
 Fig. 6. The same ; fifth abdominal somite, viewed from the side.
 Fig. 7. The same ; labrum (*lb*) and mandibles (*III*).
 Fig. 8. The same ; second maxilla.
 Fig. 9. The same ; natatory branch of the tenth pair of appendages.
 Fig. 10. The same ; abdominal appendage of the first pair.
 Fig. 11. The same ; abdominal appendage of the second pair (those of the third and fourth pairs have the same form).
 Fig. 12. The same ; abdominal appendage of the fifth pair.
 Fig. 13. The same ; telson and swimmerets.
 Fig. 14. Sixth larval stage, one moult after the fifth larval stage ; antenna of the second pair ; *sp*, spinous process.
 Fig. 15. The same ; first cheliped.
 Fig. 16. The same ; second cheliped.
 Fig. 17. The same ; one of the abdominal appendages.
 Fig. 18. The same ; telson and swimmerets.

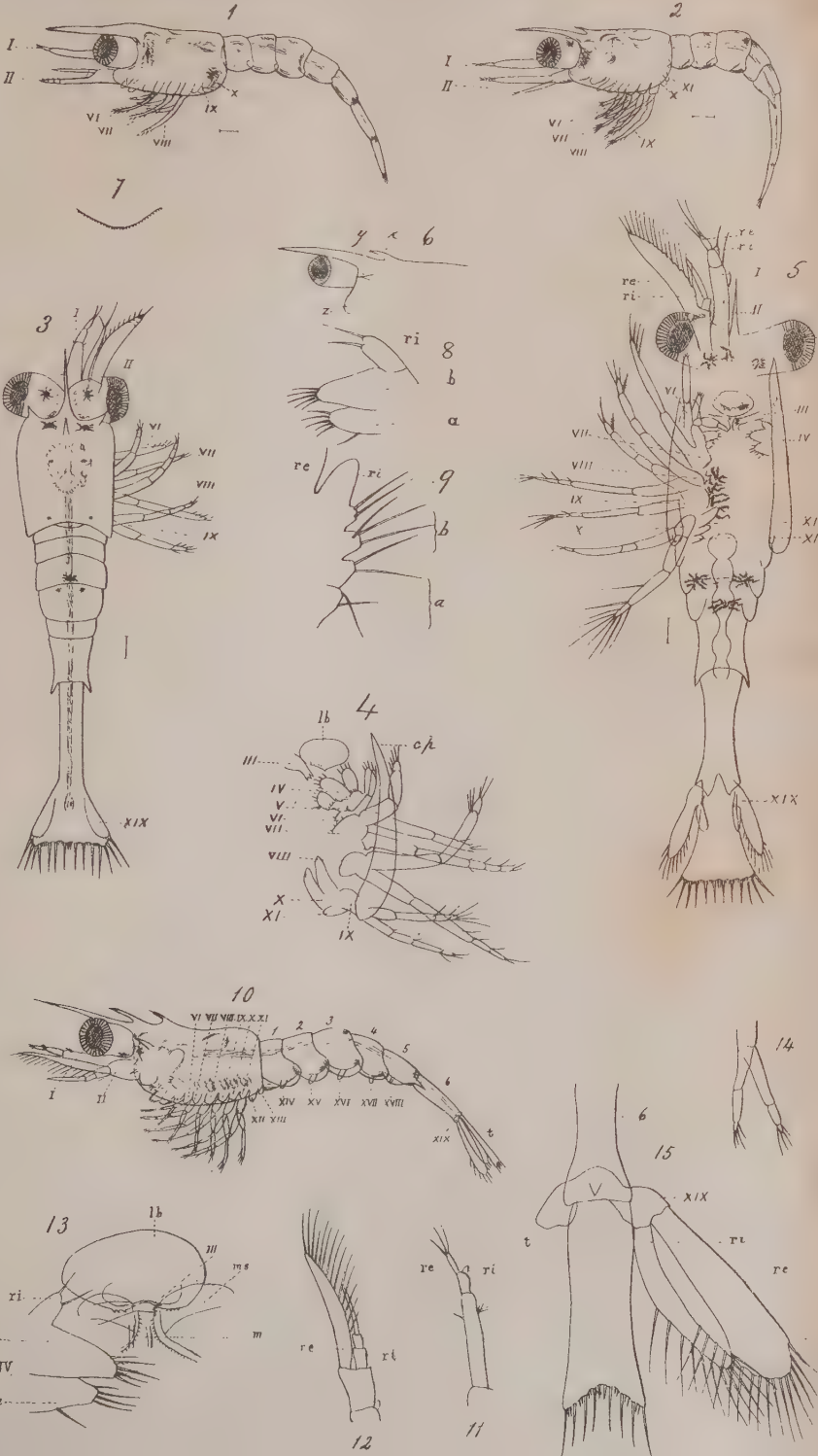
Plate IV.

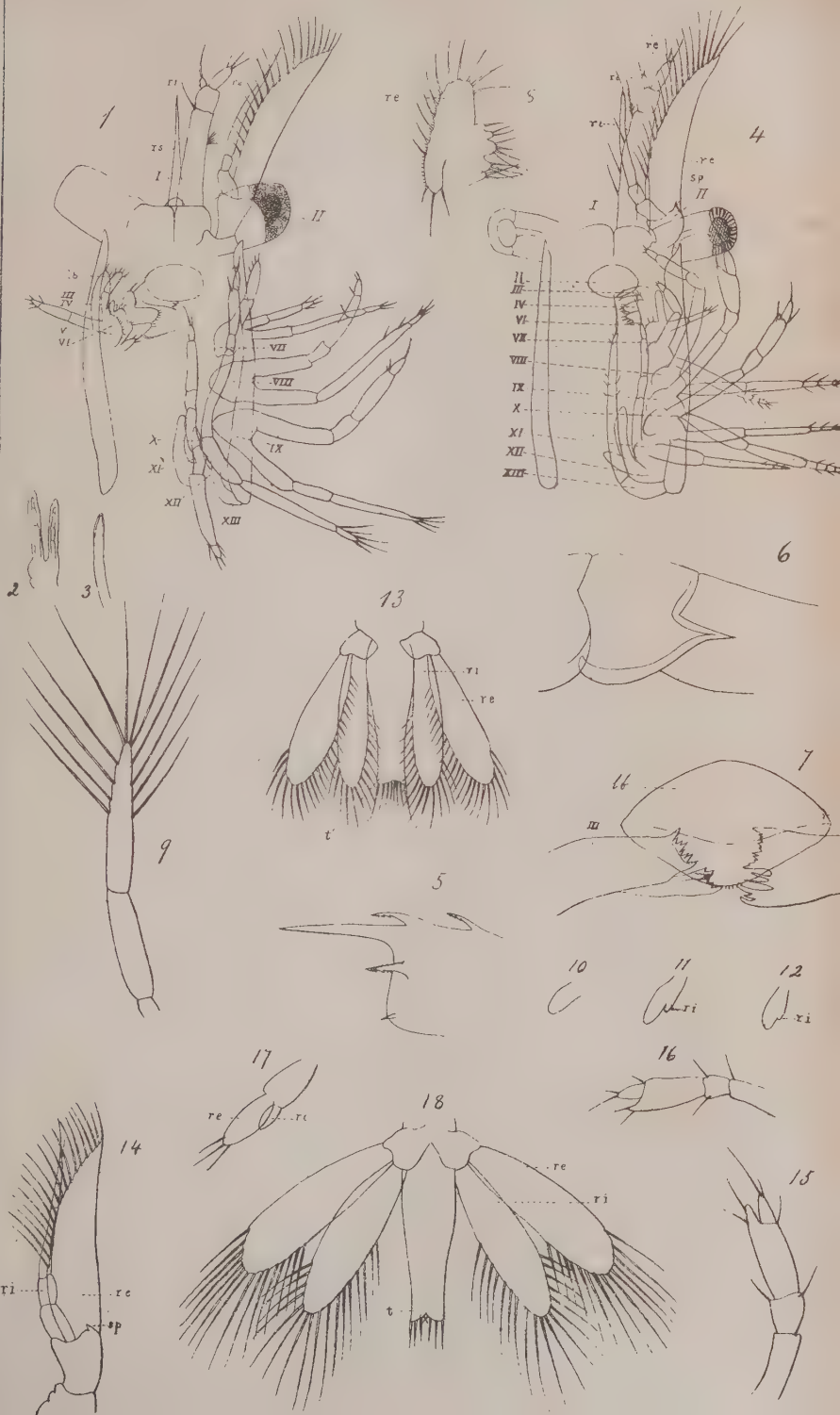
[NOTE. Figs. 9 - 14 are from drawings by Mr. A. Agassiz.]

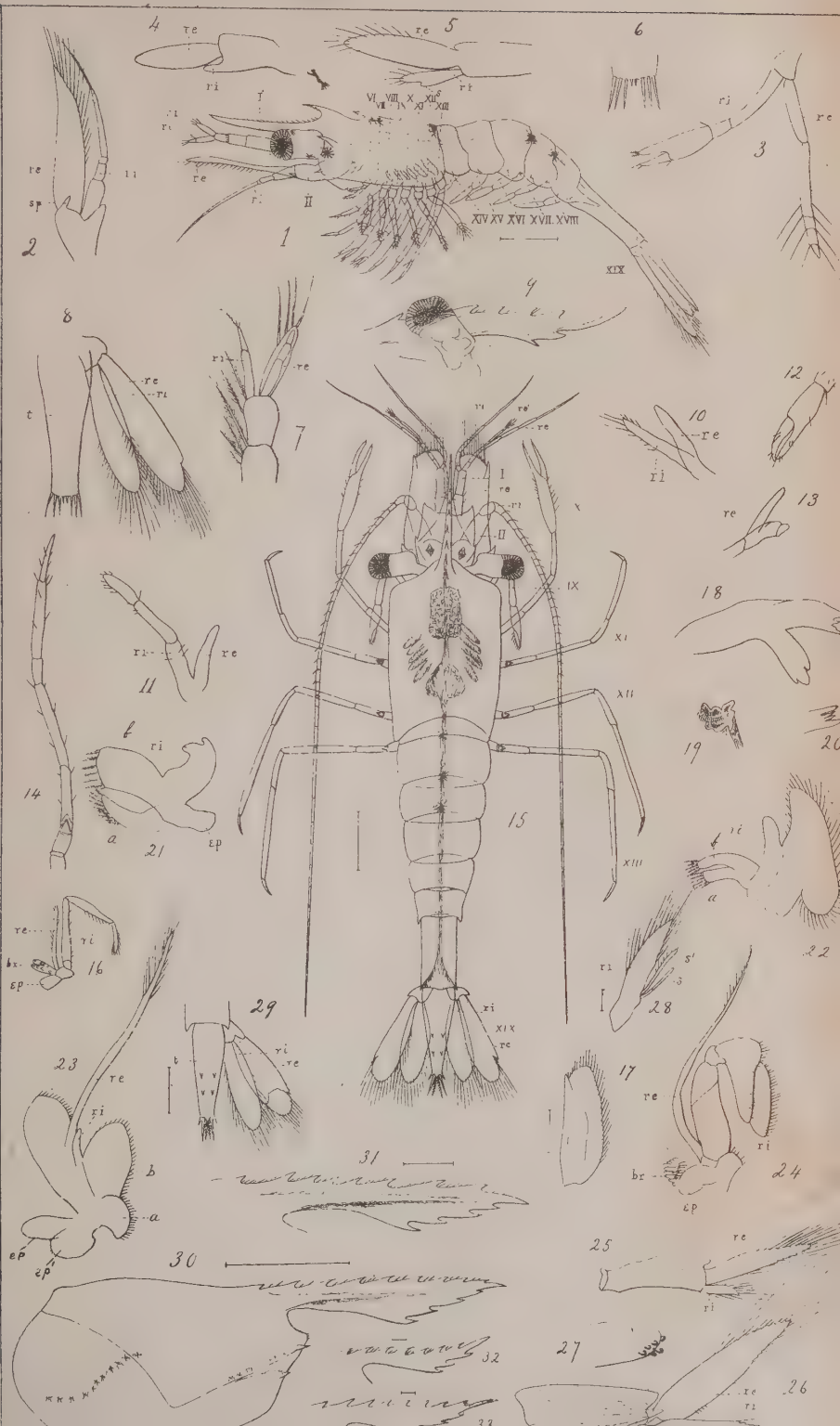
- Fig. 1. Sixth larval stage, two moults after the fifth larval stage, lateral view.
 Fig. 2. The same ; second antenna ; *sp*, spinous process.
 Fig. 3. The same ; cheliped with its external, natatory branch (*re*).
 Fig. 4. The same ; first abdominal appendage.
 Fig. 5. The same ; second abdominal appendage.
 Fig. 6. The same ; posterior margin of the telson.
 Fig. 7. Sixth larval stage, three moults after the fifth larval stage ; anterior end of first antenna.
 Fig. 8. The same ; telson and swimmeret.
 Fig. 9. Seventh larval stage ; rostrum and eye.
 Fig. 10. The same ; second maxilliped.
 Fig. 11. The same ; third maxilliped.
 Fig. 12. The same ; chela.
 Fig. 13. The same ; rudimentary external branch (*re*) of thoracic legs.
 Fig. 14. The same ; posterior thoracic leg.
 Fig. 15. Young prawn, 8 mm. long, which has acquired most of the characters of the adult.
 Fig. 16. Adult ; third maxilliped.
 Fig. 17. The same ; scale of second antenna.

- Fig. 18. The same ; right mandible.
- Fig. 19. The same ; molar crown of mandible.
- Fig. 20. The same ; end of incisor branch of left mandible.
- Fig. 21. The same ; first maxilla. *a*, inner lobe. *b*, outer lobe. *ri*, palpus. *ep*, epignath.
- Fig. 22. The same ; second maxilla. *a*, *b*, lobes of protognath. *ri*, *ramus internus*. *re*, *ramus externus*, or scaphognathite.
- Fig. 23. The same ; first maxilliped. Letters as before.
- Fig. 24. The same ; second maxilliped. *br*, gill.
- Fig. 25. The same ; first abdominal appendage.
- Fig. 26. The same ; fourth abdominal appendage. *s*, appendage on inner side of the internal branch.
- Fig. 27. The same ; tip of the styliform appendage (*s* of the preceding figure) of abdominal limbs, highly magnified to show the curled hairs.
- Fig. 28. The same ; inner branch of second abdominal appendages in the male, bearing *two* slender appendages, *s* and *s'*.
- Fig. 29. The same ; telson and swimmerets.
- Fig. 30. The same ; carapace.
- Fig. 31. Rostrum of another adult specimen.
- Fig. 32. Rostrum of the specimen represented by Fig. 15.
- Fig. 33. Rostrum of an individual 9 mm. long.









No. 10. — *On some Points in the Structure of the Embryonic Zoëa.*
By WALTER FAXON.

THE embryonic cuticle which clothes the larvæ of the higher *Crustacea* at the time when they leave the egg has been studied with more or less care by Du Cane,* Spence Bate,† Fritz Müller,‡ Gerbe,§ A. Dohrn,|| Stuxberg,¶ Claus,** and P. Mayer.†† Müller first called attention to the fact that the tail of this embryonic skin in certain genera of *Brachyura* (*Achæus*, *Maia*) resembles that of the larvæ of shrimps and prawns, and working upon this hint Mayer has shown the great morphological and phylogenetic value of a careful comparison of the caudal fin of the embryo with that of the following free-swimming stage.

While in Mr. Agassiz's laboratory at Newport, R. I., in the summer of 1879, I made some observations upon the youngest larval stages of a few *Brachyura*, especially *Carcinus mænas* and *Panopeus Sayi*. Although the former species is the subject of Spence Bate's elaborate memoir on the development of Decapod *Crustacea*, I am induced to publish my observations on account of the important discrepancies between them and those of Bate.

***Carcinus mænas*.‡†**

The young of this species are peculiarly favorable for a study of the embryonic membrane, since it is often retained for twenty-four hours after emerging from the egg. In most species, on the contrary, the first moult takes place within an hour or so after hatching; indeed, in the case of *Gelasimus pugnax* Smith, which I raised from the egg for the express purpose of examining the embryonic cuticle, I have only succeeded

* Ann. Nat. Hist., Vol. III. p. 438, Pl. XI. 1839.

† Phil. Trans. Roy. Soc. London, Vol. CXLVIII. p. 589, Pl. XL. 1859.

‡ Für Darwin, 1864. Eng. Trans. by W. S. Dallas, p. 53. 1869.

§ Comptes Rendus, Vol. LIX. p. 1102. 1864.

|| Zeitschr. Wiss. Zool., Vol. XX. p. 621, Pl. XXX. 1870.

¶ Öfvers. Kongl. Vetensk.-Akad. Förhandl., XXX. (1873), No. 9, p. 6. 1874.

** Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen-Systems, p. 62, Pl. X. Fig. 9. 1876.

†† Jenaische Zeitschr., Vol. XI., p. 246, Pl. XV. 1877.

‡† It may not be superfluous to append a list of those who have treated of the development of this common and widely distributed crab:—

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in obtaining it by extracting the embryo prematurely from the egg. In this case escape from the egg and the first moult appear to take place simultaneously.

The bursting of the egg-membranes is effected by the convulsive attempts of the imprisoned embryo to extend its abdomen, which is closely applied to the sternum within the egg. The forked tail first extricates itself (Pl. I. Fig. 1), the antennæ then protrude through the breach thus made (Pl. I. Fig. 2), and in a very short time the contortions of the animal have completely torn away the egg envelope. The embryo, swathed in a delicate, perfectly transparent cuticle, now lies on the bottom of the aquarium supinely awaiting its first moult. It is as yet incapable of swimming about and taking food, its only movements consisting of extension and flexion of the abdomen. It is not until the veil is cast off that the animal loses its embryonic character, and assumes the part of an active, free-swimming larva, with mouth parts adapted for seizing prey.

On issuing from the egg, the young measures $\frac{1}{4}$ mm. in length (Pl. I. Fig. 3). Within the transparent cuticle the zoëa may be distinctly seen as it will emerge on the first moult. The cuticle is not conformable to the underlying larval integument, as it has neither dorsal nor frontal horns, and the antennæ and tail are very different. The carapace does not at first extend far enough back to cover the base of the swimming-feet, so that the abdomen appears much longer relatively than it does a short time after hatching.

At the joints between the segments of the abdomen of the zoëa the cuticle does not follow the indentations, but otherwise rests conformably upon it. The two prongs of the forked tail of the zoëa are compressed into a very small space by means of a complex folding produced by an invagination of the middle third of the prongs, which does not involve

J. V. THOMPSON, *Phil. Trans.*, 1835, p. 359, Pl. V.

HEINRICH RATHKE, *Zur Morphologie*, p. 97. 1837.

C. DU CANE, *Ann. Nat. Hist.*, Vol. III. p. 438, Pl. XI. 1839.

H. D. S. GOODSIR, *Edinburgh New Phil. Jour.*, Vol. XXXIII. p. 181, Pl. III. 1842.

M. P. ERDL, *Entwicklung des Hummereies*, p. 27, Pl. II. 1843.

R. Q. COUCH, "*Ann. Rep. and Trans. Roy. Cornwall Polytechnic Soc. for 1843.*" (I have not seen this memoir. Some account of it is given in Bell's *History of the British Stalk-eyed Crustacea*, Introduction, pp. xlix. - liv., Figs. c, d, e, and pp. 79-81. 1853.)

C. SPENCE BATE, *Phil. Trans.*, Vol. CXLVIII. p. 589, Pl. XL.-XLVI. 1859.

V. HENSEN, *Zeitschr. Wiss. Zool.*, Vol. XIII. pp. 340, 362, Pl. XX. Fig. 25. 1863. (Auditory organ of the young.)

ANTON STUXBERG, *Öfvers. Kongl. Vetensk.-Akad. Förhandl.*, XXX. (1873), No. 9, p. 7. 1874.

the distal third which lies within the invaginated portion like a sword within its sheath. The same thing is seen in the spines which are found on each border of the caudal prongs (Pl. I. Figs. 6, 7, 12).* The tail of the embryo has an entirely different form. Each half of the fork is produced into seven long spines (Pl. I. Fig. 7). Of these, the three inner correspond to the three internal spines on the tail of the zoëa (Pl. II. Fig. 2). The fourth is the homologue of the prong itself, while the fifth, sixth, and seventh answer to the three minute ones (Pl. II. Figs. 2, 5, 6, 7), which are situated on the outer side of the fork. Curiously enough, the spines of the two stages tend to an inverse proportion, the fourth, or smallest in the embryo, being homologous with the prong of the zoëa tail, while the fifth, or largest, is replaced by one of the small external spines (5') in the subsequent stage. The fourth and seventh are naked; the rest are fringed with delicate hairs. In a few instances I found the spines of the embryonic skin invaginated in the way already described in the case of the spines of the caudal fin of the zoëa. In one example this invagination affected the second, third, and fifth spines (counting from the inside), (Pl. I. Fig. 6,) in another the third and fifth, in another the third only. Without doubt all the longer spines are thus invaginated within the egg.†

The two pairs of antennæ of the embryo, again, have a much greater development than in the zoëa, exceeding in length the swimming-feet, and reaching, when stretched backwards, beyond the base of the abdomen (Pl. I. Fig. 3). The first pair (Pl. I. Fig. 4) consists of a basal segment, within which lies the antennule of the zoëa, and which bears two branches, viz. a long one furnished with three longitudinal rows of fine setæ, and a very short one.

The second antennæ (Pl. I. Fig. 5) divide a short distance from the base into two branches, one of which has the form of a simple, blunt, finger-like process (*a*); the other divides again into three branches (1, 2, 3), which are fringed with delicate hairs. In some specimens, at the moment of issuing from the egg, one or more of these branches is infolded like an inverted glove-finger. The short and blunt process (*a*) encloses the spinous process (Spence Bate) of the antenna of the zoëa, while the triple branch (*b*), which forms the bulk of the antenna of the embryo, has its homologue in the external branch, or scale (*squamiform*

* According to Milne Edwards, the hairs of the new test of adult crabs which are about to moult are invaginated in a similar way. (*Histoire Naturelle des Crustacés*, Vol. I. p. 55. 1834.)

† Cf. Goodsir, *op. cit.*, Pl. III. Fig. 17; Claus, *op. cit.*, Pl. X. Fig. 9.

appendage of Spence Bate), of the enclosed zoëa. The flagellum of the antenna of the adult, seen in the first zoëa stage as a small protuberance (Pl. I. Fig. 10, c), has no representative in the embryonic antenna. The spinous process and scale of the zoëa antenna are much shortened by invagination, like the structures of the tail already described.*

Morphology of the Antennæ.—One can hardly avoid the conclusion that, in the same way that the seven-spined forked tail of the embryo is a reminiscence of the *Gabelschwanz* (P. Mayer) of the primitive Decapod, so the greatly developed, setiferous antennæ are an inheritance from ancestors in which these appendages subserved locomotive functions, as in the *Nauplius*. The typical second antenna of the *Zoëa* consists of a basal stem produced at its distal end into a long serrate spine (Pl. I. Fig. 10, a; Pl. II. Fig. 3, ii. a), and bearing besides an articulated squamiform appendage (b). The spine is seen in a rudimentary form in the larvæ of the shrimps, prawns, and *Paguridæ*. The squamiform appendage is homologous with the external branch of the second antenna of the larval *Macroura*, and with the antennal "scale" of the adult *Macroura*. Both the spinous process and the squamiform appendage become aborted in the development of the *Brachyura*. The flagellum of the second pair of antennæ of the adult crab is wanting in the youngest zoëa stages, or is represented by a small papilla merely (c).

If the relation of the embryonic antenna to the *Nauplius* antenna, suggested above, be correct, it follows that the bulk of the antenna of the *Nauplius* is not represented by any homologous part in the permanent antenna of the crab. If, on the contrary, it be claimed that the large fringed lobes of the embryonic antennæ simply represent antennal setæ, they still point back to a primitive condition in which the first two pairs of appendages were provided with *Schwimborsten*, and served as natatory organs.

The labrum, mandibles, metastoma, and maxillæ have nearly the same form which they have in the zoëa stage which follows. The long swimming-setæ of the first and second maxillipeds, which play so conspicuous a part in the life of the zoëa, are very much shortened by invagination, and entirely covered by the embryonic cuticle.

The third pair of maxillipeds and the two following pairs of appendages of the zoëa show through the transparent membrane as three pairs of small buds (Pl. I. Fig. 3, viii., ix., x.), but there are no corresponding structures in the embryo.

* A. Dohrn, who observed similarly formed antennæ in the embryo of a species of *Portunus* (l. c.), has confounded the two pairs.

The young remains in this embryonic condition for about twenty-four hours (at least in confinement). In the mean while it has increased in size to such a degree that the delicate investing membrane is no longer ample enough for the enclosed zoëa and the first exuviation takes place. The cuticle of the abdomen is cast first, commonly coming off in one piece (Pl. I. Fig. 9, 9'). The dorsal spine, which has been invaginated like the parts already described, and laid forward over the back, begins to be evaginated, and to erect itself, and thus aids in splitting the membrane along the back. The rostrum, which has been applied to the breast, also emerges, and the abdomen, freed from the embryonic cuticle, is now used to clear the appendages of the cephalo-thorax, in this wise: the ends of the two prongs of the tail-fork are bent so as to form minute hooks (Pl. I. Fig. 12): when the abdomen is flexed, these little * hooks catch in the membrane covering the cephalo-thoracic appendages, and on extending the abdomen again the membrane is torn off (Pl. I. Fig. 9).

The dorsal horn is commonly evaginated, and assumes its position with a slight backward curve even before the embryonic skin is entirely got rid of. In specimens which have just cast the embryonic skin, a break in the trend of the spine indicates the rim of the former invagination (Pl. I. Fig. 14). The rostral spine now projects downward at a right angle with the long axis of the body. The setæ on the various parts of the body unroll themselves, the mouth parts become functional jaws, enabling the young animal to feed; the two pairs of swimming-feet, provided each with four long swimming-setæ on their external branches, become active agents for locomotion, and now, in place of the inert and pupa-like embryo, we have a vigorous free-swimming larva.

Besides the great difference between the two stages caused by the sudden development of the dorsal and frontal spines, the two pairs of antennæ and the tail have an entirely different form. Both pairs of antennæ are now of relatively small size. Those of the first pair are composed of but one segment, which carries three long sensory threads at the tip. This segment corresponds to the basal segment of the first antenna of the embryonic stage.

The second pair of antennæ consist of a basal piece with a long serrate spinous process (Pl. I. Fig. 10, *a*; Pl. II. Fig. 3, *a*), which lies in the short, blunt process of the antenna of the embryonic stage (Pl. I. Fig. 5, *a*), and a short, blunt protuberance (Pl. I. Fig. 10, *c*), the rudiment of the antenna of the adult crab.

In addition to these processes, there is articulated to the basal piece

a long joint with a long and a short hair on its extremity (Pl. I. Fig. 10, *b*; Pl. II. Fig. 3, *b*). This is the homologue of the "scale" of the antenna in *Macroura*, and appears to represent the main, triple portion of the embryonic antenna (Pl. I. Fig. 10, *b*).

The tail (Pl. II. Fig. 2) has now the form so characteristic of the zoëa of *Brachyura*. It is a forked piece, each prong of the fork bearing three setæ on the inner side near the base, and three minute ones on the outer side. The prongs of this forked tail themselves are homologous with the fourth spine of the embryo tail, as before pointed out. The outer three (5, 6, 7) diminish in size successively.

Although I succeeded in keeping some of these zoëæ alive for seven days, none passed through another moult.

In Spence Bate's classic memoir on the development of *Carcinus mænas*, the embryonic membrane which covers the zoëa when it first quits the egg is described and figured as conformable to the whole animal, the tail and antennæ not excepted. Thus are ignored the most interesting and suggestive structural features of the embryo. This error of observation is the more remarkable, since the structures in question were figured with approximate accuracy twenty years before by that close observer, Captain Du Cane.*

H. D. S. Goodsir† also seems to have seen the same structures, although his description and figures are very incorrect. The "curious brush-shaped appendages of the embryo," which "drop off when the animal has escaped from the ovum, and are replaced by spines,"‡ are evidently the invaginated caudal spines of the embryonic cuticle, such as are represented in our Plate I. Fig. 6. Spence Bate's identification of the two pairs of swimming-feet of the zoëa with the second and third pairs of maxillipeds of the adult, instead of with the first and second pairs, was not so strange; but why does he persist in the old error, even in his latest papers,§ after it has been particularly pointed out by Fritz Müller,|| Stuxberg,¶ Claus,** and others?

* *Op. cit.*, Pl. XI. Figs. 1, 5.

† Edinburgh New Philosoph. Jour., Vol. XXXIII. p. 182, Pl. III. Figs. 16, 17. 1842.

‡ Pp. 182, 191, Pl. III. Fig. 17.

§ Report on the Present State of our Knowledge of the Crustacea. Rep. Brit. Assoc. Adv. Sci., 1875, p. 48; 1876, p. 89; 1877, p. 44; 1878, pp. 7, 8.

|| *Op. cit.*, Eng. Trans., p. 52.

¶ *Op. cit.*, p. 10.

** Würzb. naturw. Zeitschr., 1861, p. 30. Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen-Systems, p. 62. 1876.

Panopeus Sayi.

The remarkable zoëa represented on Plate II. Fig. 4, a very common form on the southern shore of New England, I raised from the eggs of *Panopeus Sayi* in the summer of 1876. It differs strikingly from all other zoëæ with which I am acquainted in the structure of the second pair of antennæ (II.), which consist of a single monstrously developed spine equal in length to the rostrum. In other regards the zoëa is not specially noteworthy. The carapace has, in addition to the rostral and dorsal spines, a pair of short lateral spines. In the middle line of the back, well forward toward the eyes, is a well-marked hump.

The caudal fork (Fig. 5) bears but four pairs of spines; the two exterior pairs (6 and 7 in *Carcinus*) are wholly wanting.

To which part of the typical second antenna of the zoëa, as described on page 162, does the long, rod-like antenna in this species correspond? In order to answer this question we must examine the cuticle of the embryo. This is represented by Fig. 8 of the plate. It has a form similar to that previously described in *Carcinus mænas* (Pl. I. Fig. 5); but here the branch marked 3 is split nearly to the base, making an apparently quadruple structure in place of the triple branch of *Carcinus*. The blunt, finger-like process (*a*) encloses the antenna of the zoëa (*a'*), which is marvellously shortened by evagination. The homology of the zoëa antenna in this case is thus fixed. It represents the spine of the normal antenna.

The cuticle covering the first pair of antennæ (Fig. 7) has the same parts as the corresponding structure in *Carcinus*, and the same with the tail (Fig. 6), in which the two external spines (6 and 7), which are entirely wanting in the first stage of the zoëa, are well developed.

EXPLANATION OF THE PLATES.

PLATE I. *Carcinus mænas*.

- Fig. 1. Embryo beginning to emerge from the egg.
Fig. 2. The same, a little further along.
Fig. 3. Embryo shortly after hatching.
Fig. 4. First antenna of the same.
Fig. 5. Second antenna of the same. The branch (3) invaginated: *a'*, spine of the antenna of the zoëa seen through the cuticle; *b'*, squamiform appendage of the antenna of the zoëa.
Fig. 6. Tail of the same: the enclosed tail of the zoëa is shaded; spines 2, 3, and 5 are invaginated.
Fig. 7. The same: all the spines of the embryonic tail evaginated.
Fig. 8. Invaginated rostrum of the zoëa, as seen through the embryonic cuticle.
Fig. 9. Young in the act of exuviating the embryonic cuticle.
Fig. 9'. The cuticle of the abdomen, just cast from Fig. 9.
Fig. 10. Second antenna of the zoëa: *a*, spine; *b*, squamiform appendage; *c*, rudiment of the flagellum of the adult. The spine and squamiform appendage are still invaginated.
Fig. 11. To show the way the dorsal spine lies at the time of the first moult. It has become evaginated, but not yet erected.
Fig. 12. Extremity of a prong of the caudal fork, to show the unfolding of the distal part, and the terminal hook.
Fig. 13. Rostrum and antennæ of a zoëa at the moment of exuviating the embryonic cuticle.
Fig. 14. Dorsal spine of zoëa immediately after casting the embryo skin. The break near the middle of the spine shows the rim of the invagination during the earlier period.

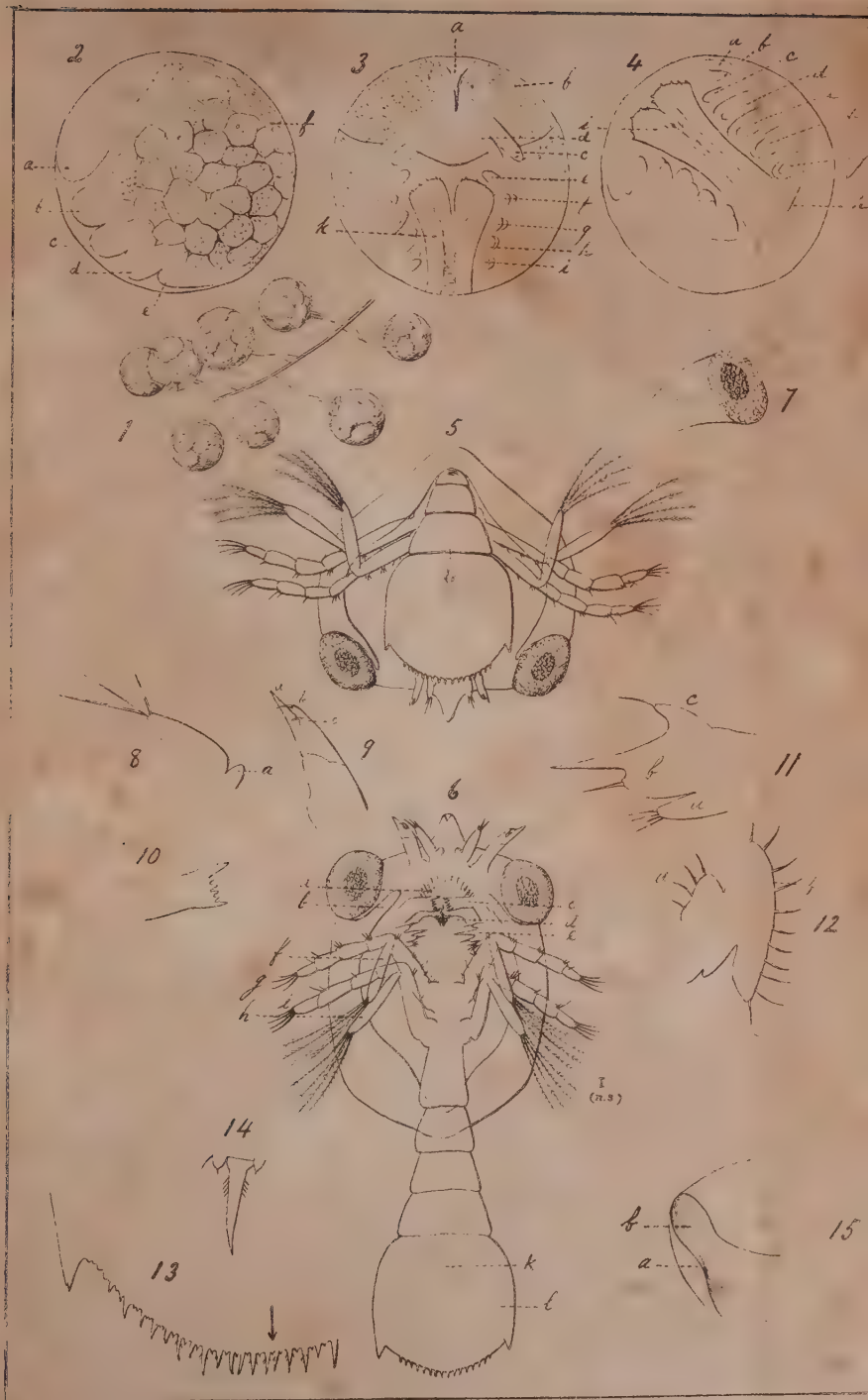
PLATE II.

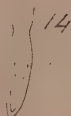
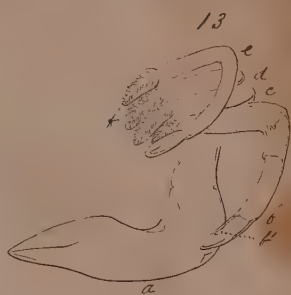
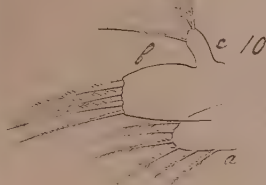
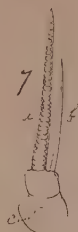
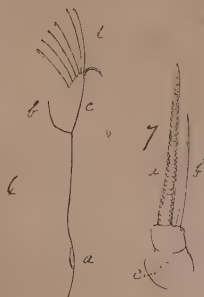
Figs. 1-3. *Carcinus mænas*.

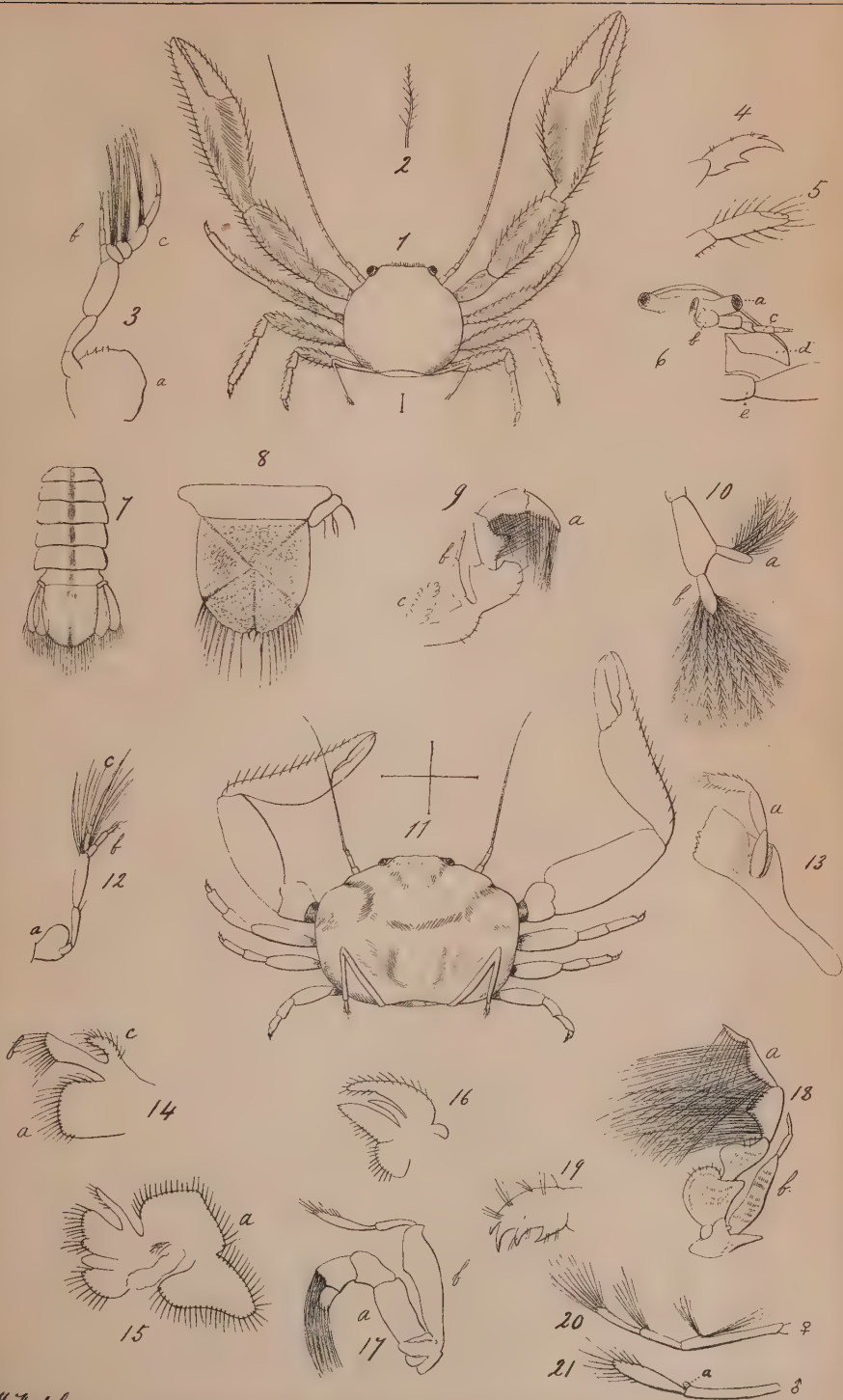
- Fig. 1. First stage of the zoëa. The appendages are marked by consecutive Roman numerals.
Fig. 2. Tail of the same.
Fig. 3. First and second antennæ of the same.

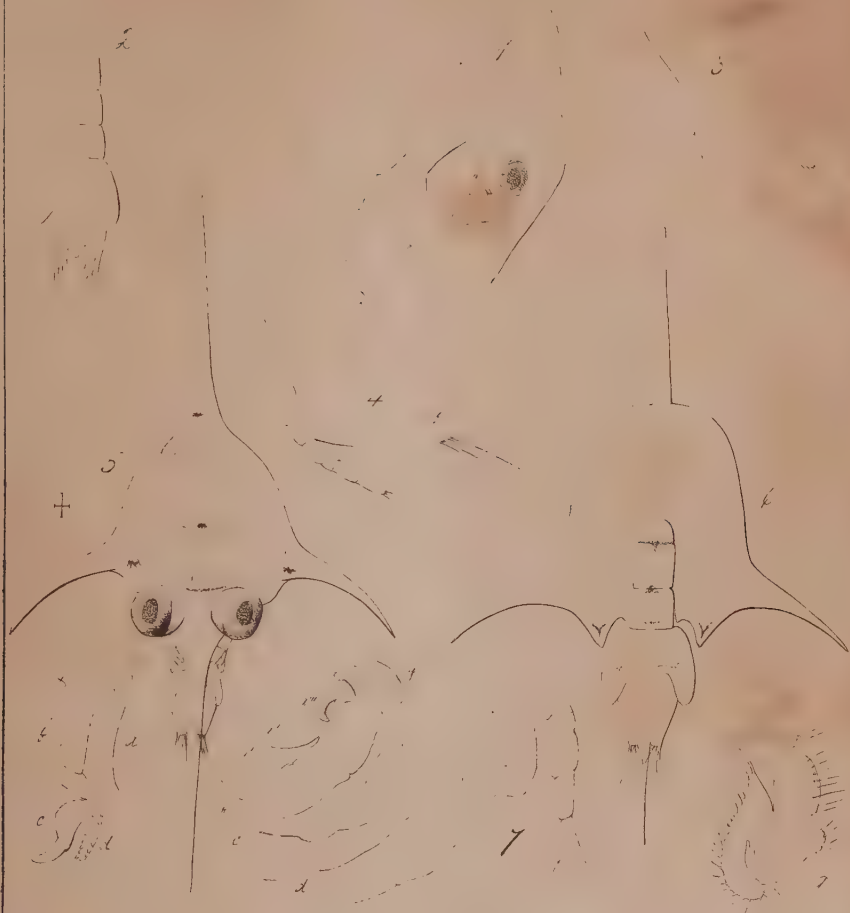
Figs. 4-10. *Panopeus Sayi*.

- Fig. 4. First stage of the zoëa.
Fig. 5. The same, viewed from behind.
Fig. 6. Tail, with the embryonic cuticle.
Fig. 7. First antenna of the embryo.
Fig. 8. Second antenna of the embryo: *a'*, antenna of the zoëa seen through the embryonic antenna.
Fig. 9. Second maxilla of embryo. The shaded part represents the appendage of the zoëa within.
Fig. 10. End of swimming-branch of first maxilliped. The long swimming-setæ are shortened by invagination and closely invested by the embryonic cuticle.
Fig. 11. Tail of *Gelasimus pugnax*, Smith, first stage of the zoëa. Spines 5, 6, 7, are entirely wanting.





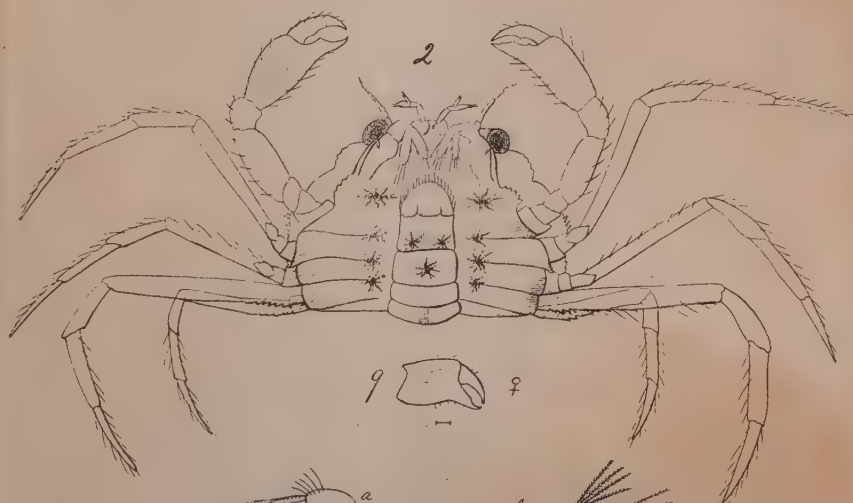




13

14

15





No. 13. — *On some Crustacean Deformities.* By WALTER FAXON.

IN November, 1879, the Museum bought of K. D. Atwood, a fish-dealer of Portland, Me., a collection of nearly two hundred deformed lobster claws. The malformations range from slight deformities resulting from incomplete restoration of lost parts, abnormal curvature of the fingers, etc., to such as may, from the enormous development of abnormal outgrowths or the duplication of parts, be truly called monstrosities. Some of the most remarkable of these specimens are here described and figured. One (Plate I. fig. 16) from the collection of the Peabody Academy of Science, Salem, Mass., for which I am indebted to Prof. E. S. Morse, a deformed claw of *Callinectes hastatus* from Chesapeake Bay (Plate II. fig. 5) kindly communicated by Dr. S. F. Clarke, of Johns Hopkins University, and an abnormal lateral spine of the carapace of the same species (Plate II. fig. 8) in the Museum of Comparative Zoölogy, are also figured. Most of these irregularities have clearly resulted, as Rösel long ago remarked of similar malformations in the European crayfish, from injuries received after moulting, before the new cuticle had become calcified.

*Plate I. Fig. 1 (right chela).** — In this claw the dactylus (*a*) is curved strongly outwards towards the index, and thrust upwards from its normal plane so that it does not meet, but crosses, the index when closed. The prehensile power of the claw is thus destroyed. From the inner border of the dactylus there is developed an enormous flattened process, which divides at the tip into two prongs (*b*, *c*), which are toothed on their opposed edges. Near the middle of the process is a deep scar (*d*), visible on both sides.

There is a specimen quite similar to this, for a drawing of which I am indebted to Prof. S. I. Smith, in the Museum of Yale College, New Haven, Conn.

Plate I. Fig. 2 (left chela). — In this specimen the dactylus is curved and bent from its true plane as in the last specimen. From the inner edge of the dactylus (*a*) arise two diverging horns (*b*, *c*), which are furnished with teeth upon their opposed edges, and simulate very closely the dactylus and index of a normal claw. The dentition of the proximal

* All the figures on Plate I. are *Homarus Americanus*, one half natural size.

horn (*b*) resembles that of the index (*a*), while the teeth of the distal horn (*c*) mark it as the analogue of the index. There is no trace of articulation at the base of either horn.

There are several specimens similar to this in the collection of the Peabody Academy of Science, Salem, and two or three in the collection of the Boston Society of Natural History.

Plate I. Fig. 3 (right chela). — Dactylus (*a*) slightly flexed from the plane of the index and broken off about an inch from the tip. From the inner side of the dactylus, near the fracture (*d*), arise two toothed processes (*b*, *c*), directed forwards, which repeat in form the lost tip of the dactylus and the tip of the index. A short, blunt process, directed upward and forward, projects from the inner margin of the dactylus, at a point a little beyond the middle.

Plate I. Fig. 4 (right chela). — Here the dactylus (*a*), a short distance from its articulation with the hand, is bent at a right angle with its normal trend, and thrown out from the plane of the hand so that it crosses the index when closed. The tip is broken off. From the untoothed margin of the dactylus, near the proximal end, proceed two processes (*b*, *c*) at an angle of about 45° to one another, the distal one (*c*) taking the normal direction of the index. Both of these processes are toothed on their opposed margins, but it is noteworthy that the teeth of the two processes are not directed exactly toward each other, but are inclined a little downward, as if by attraction to the teeth of the thumb. It is curious to observe that the toothed margins of the index and thumb are beset with an uncommonly large number of stiff setæ, and that this character is repeated in the toothed edges of the monstrous processes *b*, *c*.

Plate I. Fig. 5 (left chela). — Similar to Fig. 2, but the processes *b* and *c*, instead of diverging from one another, cross one another near their tips like the index finger and thumb of the claw when closed.

Plate I. Fig. 6 (right chela). — In this claw, unlike what we have seen in those before noticed, the prehensile power has not been lost, the dactylus closing accurately upon the index. Just beyond the middle of the dactylus springs a simple branch directed forwards at an angle of 45° with the long axis of the dactylus. This branch shows no tendency to form teeth.

Plate I. Fig. 7 (left chela). Here the dactylus (*a*) is bent near the middle, at almost a right angle with its normal direction, away from the index, but is thrown very little, if any, from its true plane of motion. It has acquired an abnormal length, and developed two processes from

its toothed margin. One of these (*b*) seems to be developed in order to recover the prehensile power which was lost by the distortion of the dactylus. The other (*c*) is broken off near its tip, but corresponds to the process *c* described in the next figure.

There is another dactylus in the collection quite similar to this.

Plate I. Fig. 8 (right chela). — This deformity belongs to the same category as the one represented by the last figure. The dactylus (*a*) is curved strongly away from the index, and lengthened. At *d* is the scar resulting from the wound that probably caused the curvature of the dactylus. An outgrowth, (*b*) provided with teeth, and meeting the thumb when the claw is closed, replaces functionally the distorted extremity of the dactylus. In addition to this a second process (*c*) projects at a right angle with the deflected part of the dactylus. This process presents a line of teeth opposite to those on *a*. My reason for considering *a* rather than *b* to be the end of the original dactylus, and *b* and *c* to be secondary outgrowths, comes from the arrangement of the punctures and the striæ on the cuticle of these parts, which seem clearly to show that *b* and *c* are the newer portions.

Plate I. Fig. 9 (right chela). — The index here is split into two parts. The outer (*a*) is toothed on its inner border. The inner (*b*, *c*) is toothed on both margins, and shows a tendency to divide at the end. The lines on the cuticle show that *a* is the original index, and *b*, *c*, a secondary process developed from it. The dactylus does not meet the index when closed.

Plate I. Fig. 10 (right chela). — The dactylus is abnormally short and curved, and its proximal half produced into a large roundish plate, toothed on its margin, only the basal part of which closes against the index.

Plate I. Fig. 11 (left chela). — A large triangular crest, directed outward and forward from the middle of the outer margin of the penultimate segment. This crest-like process has a strong curve downward.

There are several claws similar to this in the collection.

Plate I. Fig. 12 (right chela). — The inner border of the hand is distorted by a wound (*d*) which has resulted in the outgrowth of a simple, blunt, movably-jointed segment (*a'*), which evidently represents an abortive supernumerary dactylus. On its upper side (the figure shows the lower surface), near the articulation with the hand, is the small spine characteristic of the normal dactylus. The abnormal finger moves in a plane at right angles to the plane of motion of the normal dactylus.

There is another specimen in the collection similar to this, — a left

chela with a supernumerary dactylus articulated with the lower face of the hand. The dactylus is lost.

Plate I. Fig. 13 (right chela). — This specimen, like the last, is didactyle. The two dactyli (a , a') are here articulated with the hand side by side; both are thrust to one side, so that they do not close against the index finger. The index itself shows a tendency to duplication; first, by a slight bifurcation at the end; secondly, in the alteration of the tooth-bearing edge into a flat surface, bearing a row of teeth on each margin, directed toward the dactyli, but not met by them on closure.

One can easily believe that this is a congenital monstrosity, while most if not all the others on the plate are more naturally explained as malformations arising from injuries received after moulting.

Plate I. Fig. 14 (right chela). — A severe injury to the hand has resulted in the growth of a process (c) from near the base of the index, which duplicates the index. It is curved downward and inward, under the lower face of the primary index, and furnished with sharp teeth on its inner border. At the base of the toothed margin of the secondary index springs a very small process (b), which shows a line of very minute teeth on its inner border, and seems to be a rudimentary third index. The dactylus does not meet the primary index when the claw is shut.

Plate I. Fig. 15 (left chela). — The dactylus is here bent upward and outward at a right angle, at a point midway between the base and the tip. Two finger-like processes (b , b') arise near one another from the bend of the dactylus. Of these the proximal (b) is a little longer than the distal (b'). Both lie in the normal trend of the dactylus, and present a row of teeth directed towards the teeth of the distal end of the index. When the dactylus is closed, however, the teeth of neither of these processes exactly meet the teeth of the index, but fall on each side.

Plate I. Fig. 16 (left chela). This specimen resembles Fig. 12 of the same plate. From the inner and lower part of the hand arises a process (x) which is not articulated with the main portion of the hand. On its upper surface (turned away from the observer in the figure) is a prominent spine, like those developed along the inner margin of the normal hand. Articulated with the distal extremity of this process is a long, curved, pointed, toothless segment (a'), which is an imperfectly developed duplication of the dactylus (a). On the upper face of this supernumerary dactylus, close to its articulation with the process x , is the short spine characteristic of that point in the normal dactylus. The secondary dactylus almost equals in length the primary one, and, as in the example represented by Fig. 12 of the same plate, swings in a

plane nearly at right angles with the plane of motion of the normal dactylus (*a*). Here, then, in addition to the duplication of the dactylus seen in Fig. 12 (*a'* indicating homologous parts in the two figures), one sees an imperfect attempt to duplicate the propodite in the process *x*.

Plate I. Fig. 17 (left chela). — This monstrous claw is similar to the one described and figured by Lucas (*Homarus vulgaris*, in No. 7 of the Bibliography). The dactylus (*a*) does not close upon the index. From the base of the index there arises from the upper side a very large unjointed appendage, which shows a strong tendency to divide into two branches (*b*, *c*), each furnished with a row of teeth. The teeth of the branch *b* point toward the teeth of the index, while those of the branch *c* are directed toward the row of teeth on the dactylus when the latter is opened. The tendency seems to be to duplicate the dactylus in *b*, the index in *c*. As there is no articulation at the base of the monstrous appendage, the teeth on the branch *b* are useless, and as the branch *c* is not in the plane of motion of the dactylus its teeth are likewise functionless. Thus, although these two extra lines of teeth are developed, there are no two in the claw which can be applied to one another.

Plate II. Fig. 1 (*Homarus Americanus*, dactylus of right chela).* — Beyond the middle, this dactylus is bent downward at nearly a right angle. From the upper side are developed two processes (*b*, *b'*), which are forked at their ends and furnished with two rows of teeth within. The propodite is lost. Resembles the dactylus of the claw figured on Plate I. fig. 15, but differs in the fission of the processes *b* and *b'*.

Plate II. Fig. 2 (*Homarus Americanus*, one of the small chelipeds). — This leg is provided with two chelæ. One of them has the ordinary form and structure, but is bent at a strong angle with the long axis of the leg. The second claw appears to have budded off from an amputated surface of the propodite. It consists of two fingers, which have the form of the normal dactylus and index, but neither is articulated with the other at the base. The two fingers together seem to be morphologically equivalent to a single segment, and represent a two-branched supernumerary dactylus.

Plate II. Fig. 3 (*Homarus Americanus*, left chela). — In this small chela the index is curved sharply upward and deeply channelled on its lower face. Unlike all those previously noticed in this paper, this is a simple malformation through distortion, without any development of accessory parts.

Plate II. Fig. 4 (*Homarus Americanus*, dactylus of right chela). —

* All the figures on Plate II. are of natural size.

Near the base the dactylus divides into two branches, a long one (*a*), which appears to be the distal part of the original dactylus bent so as to make almost a right angle with its proximal portion, and a shorter one which forks at the end (*b*, *c*), and presents a row of teeth on both the inner and outer borders. This shorter branch has the normal direction of the dactylus, and is probably a secondary outgrowth from the primitive dactylus. This malformation resembles that seen in Plate I. figs. 7 and 8. The propodite is lost.

Plate II. Fig. 5 (Callinectes hastatus, left chela).—The dactylus is divided longitudinally, nearly to its base, and furthermore the lower of the two branches thus produced forks at a point midway between the base and the tip. One of the prongs of the fork (*c*) inclines toward the upper branch of the dactylus (*b*), the other prong (*a*) is curved downward toward the index finger. The dactylus thus becomes tridactyle instead of monodactyle. The superior branch (*b*) is toothed along its lower edge, the inferior branch along both its upper and lower edges, the teeth of the upper edge being continued along the upper margin of the upper prong (*c*), while the teeth of the lower edge are continued along the lower margin of the lower prong (*a*). All the branches are much shorter than the index finger. The teeth on *a* do not strike against those on the index when the claw is shut. Even the coloration of *a*, *b*, and *c* is like that of the normal fingers.

This monstrosity is like that described and figured by Lucas (*Carcinus mœnas*, in No. 7 of the Bibliography). I differ from Lucas in the interpretation of the finger-like parts of the tridactyle segment. He considers *b* to be the normal dactylus, and *a* and *c* to be supernumerary fingers, *a* being the analogue of the dactylus (*b*), and *c* the analogue of the index. From the analogy of this deformity with those represented on Plate I. figs. 1–5, I conceive *a* to represent the original dactylus, and *b* and *c* to be the supernumerary parts, representing the dactylus (*a*) and the index respectively.

Plate II. Fig. 6 (Homarus Americanus, right cheliped).—The first segment (coxa) is wanting. The second and third segments, instead of having their normal flattened form, are subcylindrical. The third segment (meros) further shows a tendency to divide, a deep groove running across the distal end. The upper half of this segment repeats antitropically, or in a reverse manner, the lower half: thus the spine *sp* on the anterior border is symmetrically repeated in *sp'*, and the articulating process *z* has its homotype in *z'*. The symmetry of the segment is not complete, however, inasmuch as the two or three short spines on the

internal border of the segment (turned away from the reader in the figure) are not duplicated on the homologous margin of the upper half of the segment. Articulated with the distal end of this segment are two carpi (4, 4'). The supernumerary carpus (4') does not have the exact form of the normal carpus (4), but is slenderer, subcylindrical, and much more spiny. The normal carpus is followed by a propodus and dactylus (5, 6) of the regular form. The supernumerary carpus bears at its distal extremity an abortive propodus (5') in the shape of a small stump-like segment, bifurcated at the end and armed with a blunt spinous tubercle (y') on its inner margin. This tubercle is homologous with the tubercle y at the proximal end of the external border of the normal propodus. Curiously, the supernumerary carpus is set upon the meros in a position almost the reverse of that of the normal carpus, so that the surface of the accessory carpus and propodus, which is homologous with the upper surface of the regular carpus and propodus, looks in almost the opposite direction. It is as if the abnormal carpus were rotated upon the meros through nearly 180° to the left. It thus comes about that the articular tubercle x' falls on the same side with its homotype, x , instead of on the opposite side, as one would expect from the reversed symmetry of the two carpi. If the two propodal segments (5, 5') were flexed at the same time, they would move in nearly opposite directions. This distortion seems to me very singular, and I think nothing like it has been observed among the many cases of double legs in insects.

In this specimen we have the nearest approach to complete duplication of a limb yet observed among Crustacea. It reminds one of the monstrosities among insects, frequently described by entomologists, in which the duplication of a leg may involve all the joints down to the trochanter. Whether this monstrosity be congenital, or the result of injuries received later in life, I cannot tell.

Plate II. Fig. 7 (Homarus Americanus, left chela). — In this small chela only a rudiment of the index is present, and the dactylus is curled underneath it in the form of a semicircle.

Plate II. Fig. 8 (Callinectes hastatus, left lateral portion of the carapace). — The lateral horn, instead of being simple, as in normal specimens, has three spines, one directed forward, outward, and downward, one backward, outward, and upward, and one, very small in size, backward, outward, and downward.

Plate II. Fig. 9 (Homarus Americanus, right chela). — The whole of the index as well as part of the hand is wanting in this sadly mutilated

claw. The amputated part was evidently removed when the shell was soft, and the wound has completely healed. The dactylus has the form of a cylindrical stunted segment, with an imperfectly developed line of teeth on its cutting surface. The character of the shell leads me to believe that the amputation passed through the line indicated by x , and that the part of the hand distal to this, as well as the dactylus, was reproduced by budding after the wound was received.

Although as early as 1671 the fanciful Von Berniz (No. 1) described and figured two misshapen Crustacean claws, the number of deformities among animals of this class recorded by naturalists is small compared with those observed in insects. Of the thirty cases which I find hitherto recorded, fifteen belong to the European crayfish (*Astacus fluviatilis*).* Leaving out of account the claw represented by Fig. 3 on Plate II., in which we have a simple distortion arising from an abnormal curvature of the fingers, it appears that all the deformities just described belong to the two categories of *monstrositates per defectum* and *monstrositates per accessum*. The former (such as Plate II. figs. 7, 9) are without doubt the result of an accidental amputation of certain parts when the animal was soft-shelled, which parts would probably have been restored after subsequent moults if the animal had lived. Such deformities can hardly be termed true monstrosities, and are of minor interest. The latter, — in which category all the other cases figured will be included, — while accompanied in most cases by a distortion of normal structures, and probably for the most part the result of injuries, present irregular, secondary outgrowths, and are of considerable interest. Among these we have, *first*, cases of duplication of joints in a limb (as in Plate I. figs. 12, 13, 16, Plate II. fig. 6), similar to the many cases described among insects; *secondly*, processes budding out from either the propodus (Plate I. figs. 9, 11, 14, 17) or the dactylus (Plate I. figs. 1–8, 15, Plate II. figs. 1, 4, 5) without any articulation. These processes frequently simulate a true claw in a marvellous manner, e. g. Plate I. figs. 1–5, and are worthy of especial attention. A Crustacean claw is, morphologically viewed, a composite structure involving two segments of the series of seven which are found in the typical leg. The ultimate segment of the series develops teeth along its inner border, and when flexed closes against an immovable toothed process from the penultimate segment. But in these fictitious claws (see Plate I. figs. 2, 5, etc.) the two

* It is remarkable that in the vast number of American crayfishes examined by Hagen in the preparation of his *Monograph of the North American Astacidae*, no deformities, strictly speaking (see p. 269), were observed.

digits *b*, *c*, are simply processes developed from the ultimate segment of the leg without the least mobility. We have here a structure which is neither morphologically nor functionally a claw, but only a counterfeit of one. What force produces the perfect development of teeth on the opposed edges of these immovable digits, where they cannot be of the slightest service? It is to be observed that these spurious chelæ are always found on the dactylus of claws which have lost their function through the displacement of the dactylus. In such cases there seems to be a futile effort to form a new claw in the way indicated. When one sees how perfectly the dactylus *a* (e. g. in Plate I. fig. 5) is repeated in the process *b*, and the index in the process *c*, even to the details of dentition and setæ, he is at once tempted to call upon Darwin's hypothesis of pangenesis† to explain the resemblances. It will be observed (see Plate I. figs. 13, 16, Plate II. fig. 6) that a movable dactylus may be duplicated on the propodal segment, but in no case is an *articulated* segment developed from the dactylus.

It would be extremely interesting to know whether these monstrous developments are perpetuated throughout the life of the individual, or whether they are got rid of by exuviation. The latter seems hardly probable. Huxley‡ says the deformities persist, but whether this statement be based on observation or not, I do not know.

As the specimens which have come under my observation are dry, and the soft parts removed, I can record nothing concerning the arrangement of the muscles, nerves, and arteries in those deformed claws. What modifications of the soft parts are brought about by the deformities would be a most interesting subject of study for any one who may come into possession of such specimens in a fresh or alcoholic state.

Almost all the malformations of the hard parts of Crustacea which have been described are confined to the big claws. These claws, being the chief weapons of offence and defence, are much more liable to receive wounds than any other part of the body, and, as before pointed out, deformities such as are described in this paper are undoubtedly in most cases the result of injuries. Rösel (No. 4) speaks of deformities of the rostrum of crayfishes; Herklots (Nos. 11, 15) describes and figures a triple dactylus of the second pair of legs in *Lithodes arctica*; A. Milne

* In such specimens as that figured on Plate I. fig. 8, where the chela has its functional power, the spurious claw is formed in a different way, *a* being the original dactylus. See p. 258.

† The Variation of Animals and Plants under Domestication, Vol. II. Ch. XXVII.

‡ The Crayfish. An Introduction to the Study of Zoölogy, p. 39, 1880.

Edwards (No. 12, see p. 268) records a monstrosity affecting the eye-stalk of *Palinurus penicillatus*; and finally Packard (No. 17) has noticed a deformity of the caudal spine of *Limulus Polyphemus*. The last is probably not so rare as Packard supposes, as I have found two specimens of *Limulus* with similarly deformed spines. There is also in the Museum of Comparative Zoölogy a small deformed specimen of *Limulus Polyphemus*, in which the left side of the gill-bearing segment of the body is marked by a deep concavity and absence of the lateral spines. Further, Figs. 2 and 8 on Plate II. of this paper portray deformities of other parts than the great claws. Fig. 2 represents a monstrous condition of one of the small chelipeds of the lobster, and there is another specimen in the Museum in which the index or immovable finger of the chela of either the first or second pair of legs is double. Another lobster presents a deformity of one of the third pair of maxillipeds, the terminal segment being divided into three lobes. Plate II. fig. 8 represents a deformed lateral spine of the carapace of *Callinectes hastatus*.

Reviewing all the deformities which have been described among Arthropods, I would divide them into five categories, as follows.

Deformities :— *a*, of deficiency.

b, of excess.

c, of transformation.

d, of arrested development.

e, of hermaphroditism.

a. In individuals affected with deformities of this class, certain parts normally present are wanting. Among Crustacea such cases are, as far as I am aware, never congenital, but result from accidental amputation of parts commonly restored by new growths, as before observed.

b. *Monstra per accessum*. Under this head fall the majority of the monstrosities that have been described among Arthropods. Among insects the numerous cases recorded by Asmus,* Mocquerys,† various contributors to the *Annales de la Société Entomologique de France*, and lately by Jayne,‡ etc., etc., for the most part belong here. In these cases it is commonly the antennæ and legs which are the seat of the monstrous developments, which usually take the form of a duplication, or even triplication, of the appendage. In most cases such double or triple appendages are single at the base, the duplication or triplication

* *Monstrositates Coleopterorum*, 1835.

† *Recueil de Coléoptères anormaux*, 1859.

‡ Descriptions of some Monstrosities observed in North American Coleoptera, *Trans. Amer. Ent. Soc.*, VIII. p. 155, 1880.

involving only the distal segments. In the leg, for instance, all the segments beyond the coxa may be duplicated, while in other cases one or two of the distal joints of the tarsi alone will be repeated.

Among Crustacea the examples of a real duplication or triplication of segments in an appendage are very rare. The most marked instance of the kind is afforded by the lobster cheliped figured on Plate II. (Fig. 6) of this paper, in which there is a clear tendency to duplication, at least from the coxa onward. Duplication of the dactylus is seen in Plate I. figs. 12, 13, 16, and in Plate II. fig. 2.* Jäger (No. 10, p. 38, figs. 12, 13) has described and figured a claw of *Uca una* with two dactyli, and a similar case in *Eriphia spinifrons* has been published by Herklots (No. 15, figs. 6, 7, 8).

On seeing such a specimen as the *Prionus* figured by Jayne,† in which the tibiæ and tarsi are duplicated in all the legs, and perfectly symmetrical on the two sides of the body, one cannot doubt that in insects at least these monstrosities by duplication may be referred to a *vitium primæ conformationis*, and in examples from Crustacea such as those represented by Fig. 13, Plate I., and Fig. 6, Plate II., of this paper, it is very probable that we are dealing with a monstrosity which is not the result of injury.

Most of the *deformities by excess* among Crustacea, however, do not result from a true duplication of more or fewer segments of an appendage, but from the outgrowth of unarticulated processes of various shapes, often furnished with teeth, and simulating true segments. But in such cases, e. g. where there is a process that has the form of a supernumerary dactylus, we find that it is commonly developed from the normal dactylus, and devoid of any articulation, instead of joining by an articular surface with the propodus as a true supernumerary dactyle would do.

In this category the *Astaci* noticed by Emmanuel Rousseau (No. 8) and Eugène Desmarest (No. 9) will also be included. In these abnormal female specimens an extra pair of vulvæ were present on the basal segment of the fourth pair of legs, the oviduct of each side dividing into two branches after leaving the ovary.

c. Monstrosities of this class result from an organ being replaced wholly or in part by another organ. Such monstrosities are common in plants, but exceedingly rare in animals. A few have been described

* There are two or three lobster claws with two dactyli in the collection of the Peabody Academy of Science, Salem.

† *Op. cit.*, Plate IV. fig. 12.

among Arthropods. I am indebted to Dr. Hagen for references to the following cases among insects :—

1. *Prionus coriarius* with two perfect legs in place of the elytra.*
2. *Cimbex axillaris* with a claw like those of the tarsi, on the end of the left antenna.†
3. *Zygæna filipendulæ* with one of the hind legs replaced by a wing.‡

Among Crustacea the only example of this kind of monstrosity is the *Palinurus penicillatus* described by A. Milne Edwards (No. 12), in which a flagellum like one of those of the antennules is developed from the centre of a rudimentary cornea on the end of the eye-stalk.

Monstrosities of this class are especially interesting on account of their bearing on the morphology of organs. If we admit teratological conditions as evidence of homology, as the botanists do in the case of the metamorphosis of the parts of a flower, we must regard the wings and legs of insects, as well as the eye-stalks and antennæ of Crustacea, as morphological equivalents,§ a view which is not supported by the mode of development of these parts in the embryo.

* Saage, *Preussische Provinzial Blätter*, Vol. XXII. p. 191, 1839; *Stettin. Entomol. Zeitung*, Vol. I. p. 48 (cited from Hagen, On some Insect Deformities, *Mém. Mus. Comp. Zoöl.*, Vol. II. No. 9, p. 22, 1876).

† G. Kraatz, Ueber eine merkwürdige Monstrosität bei *Cimbex axillaris* (Hymenopt.), *Deutsche Ent. Zeits.*, XX. Heft II. p. 377, Taf. I. fig. 8 a, a, b, 1876.

‡ N. M. Richardson, *Nature*, Vol. XVI. p. 361, August 30, 1877. Dr. Hagen tells me that he is sure he has seen another similar case recorded, but he has lost the reference to it.

§ Dr. Hagen (in his lectures) also adduces evidence from comparative anatomy of insects to support the theory of the homology of wings and legs. Most authors (Gegenbaur, Lubbock, Fritz Müller, etc.) who have discussed the question of the morphology of insects' wings consider them to have originated independently of the ventral appendages, as tracheal gills or otherwise. Balfour (*Treatise on Comparative Embryology*, Vol. I. p. 337, 1880) even doubts whether the antennæ of insects have the same morphological value as the succeeding appendages! None of these writers take notice of the above-mentioned monstrosities in this connection.

With reference to the homology of eye-stalks and antennæ in Crustacea, A. Milne Edwards (No. 12), Gerstaecker (*Bronn's Klassen und Ordnungen des Thier-Reichs*, V., 1 Abt., 1 Hälfte, pp. 202, 343, 1868), and Rolleston (*Forms of Animal Life*, pp. 113, 119, 1870) bring forward the abnormal development of an antennular flagellum from the eye-stalk in the *Palinurus* mentioned above as proof of the homology of the eye-stalk with the antenna, a view long ago advanced by Savigny and H. Milne Edwards. The embryologists on the other hand, as Claus and Fritz Müller, generally deny the equivalence of the parts in question. E. van Beneden says of the eye-stalk in *Mysis*: "Ce pedicule n'apparaît aucunement comme les autres appendices, et paraît avoir une autre valeur morphologique." (*Bull. Acad. Roy. de Belgique*, 2 Ser.,

d. The existence of dimorphism among the males of the genus *Cambarus*, first observed by Agassiz, has been fully discussed by Hagen (No. 16), who conjectures from the resemblance of the "second form" males to young individuals and the small development of the internal organs of generation, that they are sterile. In *Lupa* and some other genera of *Brachyura* dimorphism occurs in the females, many full-grown specimens having a narrow and acute abdomen, instead of the broad, roundish abdomen of the normally developed individuals. Agassiz learned from anatomical examination that the females with a narrow triangular abdomen were sterile.

These sterile forms may be properly classed among abnormal variations caused by arrest of sexual development.*

e. *Hermaphroditism*.—While numerous cases of hermaphroditic insects have been put on record by entomologists, I can find but two undoubted cases of hermaphroditism among Crustacea outside of those groups in which it is the normal condition, viz. the Cirripeds and parasitic Isopods. The first case is that of a lobster (*Homarus vulgaris*) described and figured by F. Nicholls, in 1730, in the Philosophical Transactions of the Royal Society of London (No. 3 of the bibliographical list appended to this paper). In this specimen the right half of the body was female, the left half male, as regards both internal and external organs. The second case is a similar one of *Eubbranchipus vernalis*, lately described by Gissler (No. 18).

E. von Martens (No. 14) has published an account of three specimens of *Cheraps* from Adelaide, with openings in the first segment of the third pair of legs answering to the sexual apertures of the normal female, coexisting with the normal male sexual orifices in the first segment of the fifth pair of legs. An examination of the internal parts showed the coiled *vasa deferentia* of the normal male opening out through the apertures in the fifth pair of legs. No ovary or duct leading to the openings in the third pair of legs was detected. The specimens had lain in alcohol some seven years, however, so that the evidence against the existence of any internal female organs cannot be taken as positive. Similar open-

XXVIII., 1869). Gegenbaur (Grundzüge der vergleichenden Anatomie, 2^{te} Aufl., p. 397, 1870) also excludes the eye-stalk from the series of appendages.

* Among insects the *Phalaena heteroclita* [*Bombyx monacha* ?], described by O. F. Müller (an imago with the head of the larva), is probably to be explained as a deformity arising from arrest of development. In other cases recorded of the retention of the larval head by a perfect insect, the head of the imago was probably within the head of the larva, which was not cast off at the time of transformation. See Hagen, On some Insect Deformities, *Mem. Mus. Comp. Zool.*, Vol. II. No. 9, 1876.

ings were seen in the third pair of legs of male *Parastacus pilimanus* and *P. Brasiliensis*.

Abnormal cases of hermaphroditism in Decapods acquire a peculiar interest in the light of the recent discovery of hermaphroditism as the normal condition in another group of the higher Crustacea, viz. the parasitic Isopods.* Mayer has even found indications of hermaphroditism in *Cirolana* and *Conilera*, genera of free Isopods.†

* Bullar, The Generative Organs of the Parasitic Isopoda, *Jour. Anat. and Physiol.*, XI. p. 118, 1876. Id., Hermaphroditism among the Parasitic Isopoda, *Ann. Mag. Nat. Hist.*, 4 Ser., XIX. p. 254, 1877.

Paul Mayer, Ueber den Hermaphrodismus bei einigen Isopoden, *Mittheilungen aus der Zoolog. Station zu Neapel*, I. p. 165, 1878.

† *Op. cit.*, p. 177.

CAMBRIDGE, March, 1881.

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(Right side female, left side male. See p. 269.)
4. AUGUST JOHANN RÖSEL VON ROSENHOF. Fernere Beschreibung des hiesigen Fluskrebsses und seiner merkwürdigen Eigenschaften. *Der monatlich-herausgegebenen Insecten-Belustigung dritter Theil*, p. 344, Tab. LX. fig. 28, 29, Tab. LXI. fig. 30-33. 1755. Figures copied in *Encyclopédie Méthodique*, Vol. 191, Pl. 290, fig. 1-6, 1830, and by JÄGER in No. 10, fig. 4-6, 9-11.
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(Female *Astacus fluviatilis* with two pairs of vulvæ on the base of the third and fourth pairs of legs.)

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(Female *Astacus fluviatilis* with four vulvæ disposed as in the one described by ROUSSEAU. Two oviducts on each side pass from the genital apertures to unite in a common trunk before reaching the ovary.)
10. G. JÄGER. Vergleichende Darstellung der missgebildeten Scheeren des gemeinen Flusskrebse (*Astacus fluviatilis*) und der missgebildeten Scheere einer Krabbe (*Cancer uca* Linn. *Uca Una* Latr.) aus Surinam. *Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg*, Jahrg. VII., p. 33, Pl. I. 1851.
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(Deformed dactylus of the second pair of legs of *Lithodes arctica*.)
12. ALPHONSE MILNE EDWARDS. Sur un Cas de Transformation du Pédoncule oculaire en une Antenne, observé chez une Langouste. *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences*, Tome LIX. p. 710. 1864.
(Antennular flagellum developed from the end of the eye-stalk in a *Palinurus penicillatus* from Mauritius.)
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Notes on Amerian Crustacea. No. I. Ocypodoidea. *Transactions of the Connecticut Academy of Arts and Sciences*, Vol. II. p. 133, 1870.
(Notice of an anomalous specimen of *Gelasimus pugnax* Smith, in which the chelipeds were nearly equal in size and form.)
14. E. VON MARTENS. *Sitzungs-Bericht der Gesellschaft naturforschender Freunde zu Berlin* am 18 Jan., 1870, p. 1.
(Male specimens of *Cheraps plebejus*, *Parastacus pilimanus*, and *Parastacus Brasiliensis*, with openings in the first segment of the third pair of legs representing the genital orifices of the female. See p. 269.)
15. J. A. HERKLOTS. Misvormingen bij Schaaldieren waargenomen. *Tijdschrift voor Entomologie, uitgegeven door de Nederlandsche Entomologische Vereeniging*, XIV. Jaargang, p. 69, Pl. I. 1871.
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17. A. S. PACKARD, JR. The Development of *Limulus Polyphemus*. *Memoirs of the Boston Society of Natural History*, Vol. II. p. 201, fig. 36. 1872.

(Forked caudal spine.)

18. C. F. GISSLER. Description of a Hermaphroditic Phyllopod Crustacean (*Eubbranchipus*). *The American Naturalist*, Vol. XV. p. 136, fig. 1-3. 1881.

(*Eubbranchipus vernalis*, showing lateral hermaphroditism both in the external claspers, etc. and in the internal genital organs. The internal female organs are but poorly represented, — although a single egg was observed in the ovarian string, — while the internal male organs have their normal size and shape.)

EXPLANATION OF THE PLATES.

[NOTE. — A detailed description of the specimens figured in the plates will be found on pp. 257-264. Unless otherwise stated, the specimens are in the Museum of Comparative Zoölogy, and were obtained from K. D. Atwood, Portland, Me. Those figured on Plate I. are reduced one half. Those figured on Plate II. are of the natural size.]

PLATE I.

- Fig. 1. *Homarus Americanus*, right chela.
 “ 2. “ “ left “
 “ 3. “ “ right “
 “ 4. “ “ right “
 “ 5. “ “ left “
 “ 6. “ “ right “
 “ 7. “ “ left “
 “ 8. “ “ right “
 “ 9. “ “ right “
 “ 10. “ “ right “
 “ 11. “ “ left “
 “ 12. “ “ right “
 “ 13. “ “ right “
 “ 14. “ “ right “
 “ 15. “ “ left “
 “ 16. “ “ left “

(From Mus. Peabody Acad. Science, Salem, Mass.)

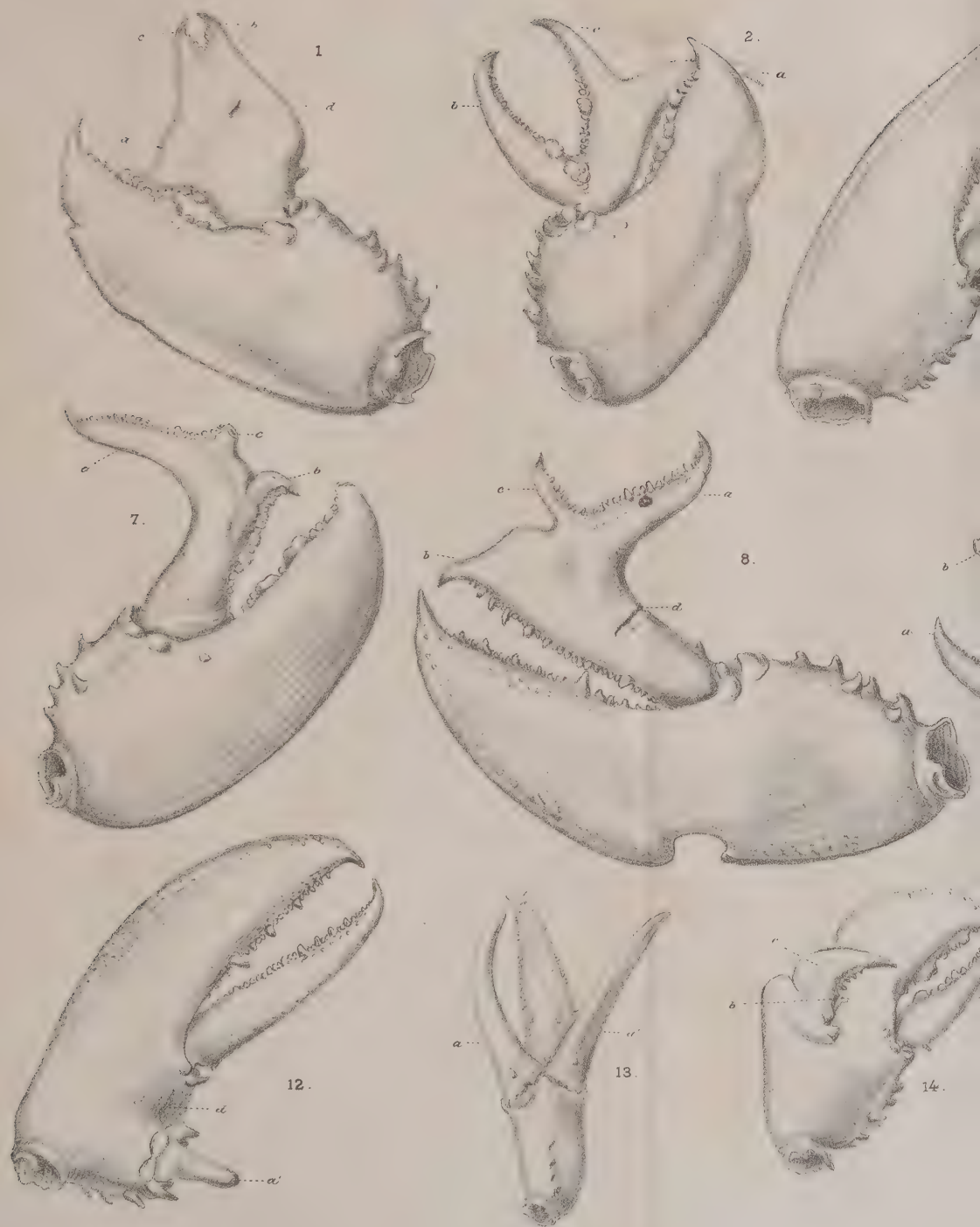
- “ 17. *Homarus Americanus*, left chela.

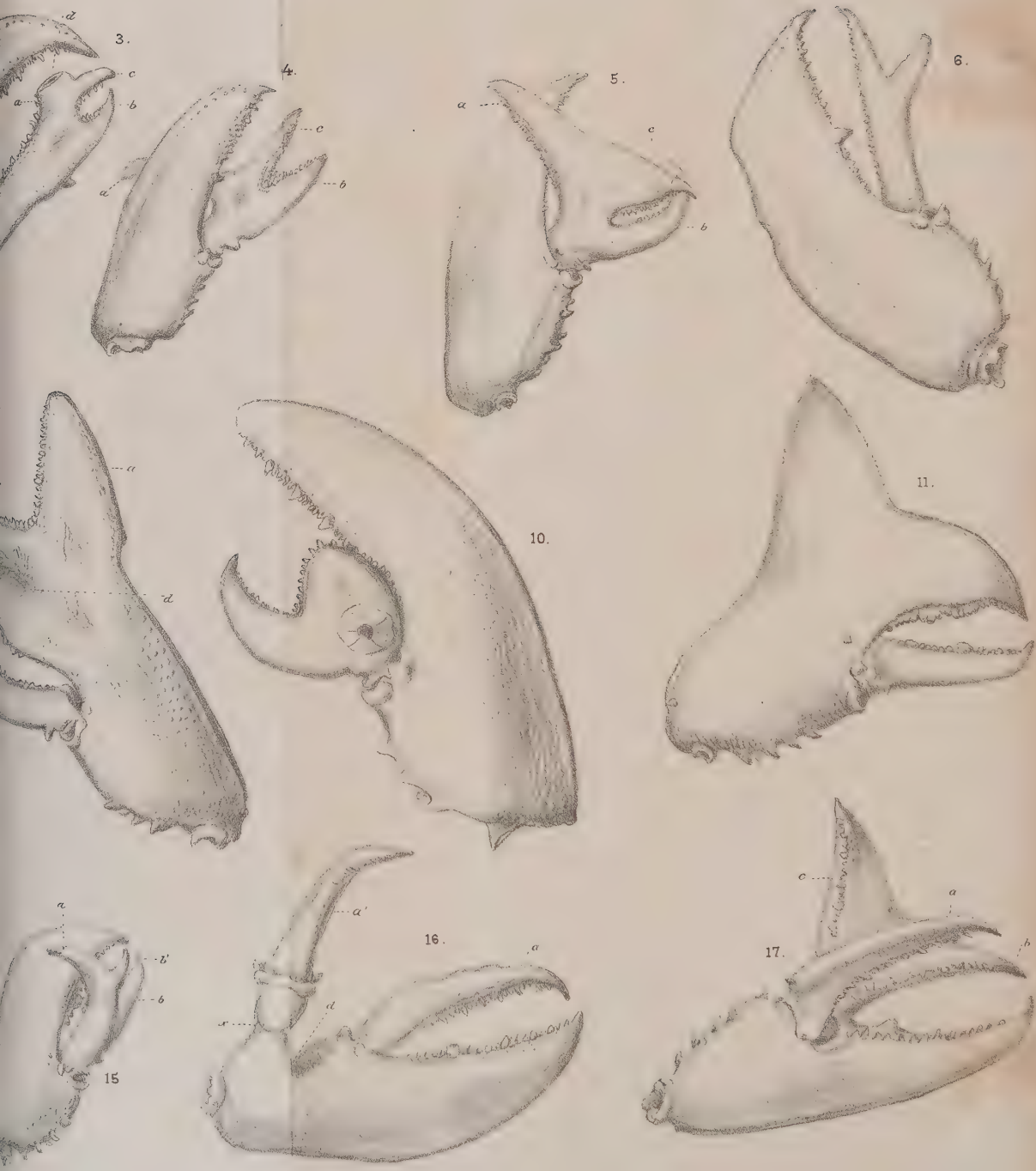
PLATE II.

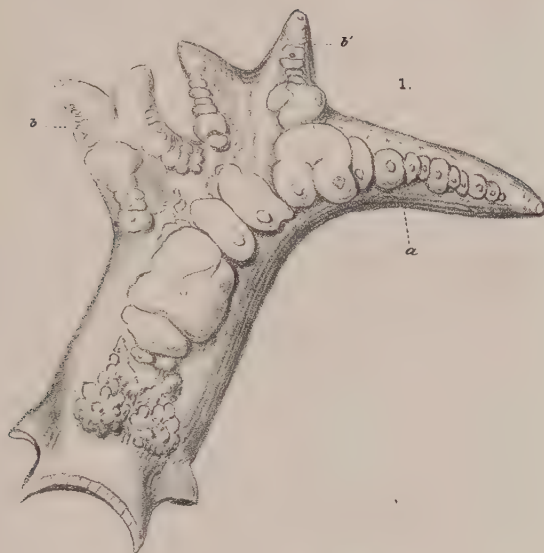
- Fig. 1. *Homarus Americanus*, dactylus of right chela.
 “ 2. “ “ one of the small chelipeds.
 “ 3. “ “ left chela.
 “ 4. “ “ dactylus of right chela.
 “ 5. *Callinectes hastatus*, left chela.

(From Chesapeake Bay; coll. Dr. S. F. Clarke.)

- “ 6. *Homarus Americanus*, right cheliped.
 “ 7. “ “ left chela.
 “ 8. *Callinectes hastatus*, left lateral part of the carapace with branched spine.
 (Coll. M. C. Z.)
 “ 9. *Homarus Americanus*, right chela.









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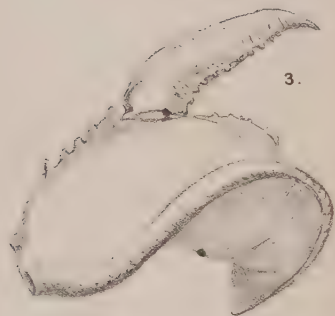
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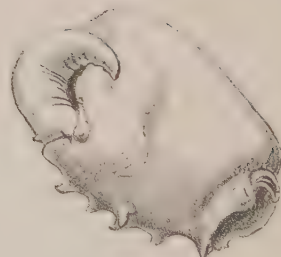
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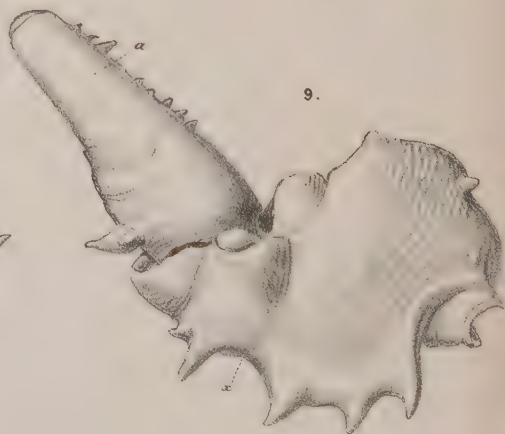
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No. 6. — *Bibliography to accompany "Selections from Embryological Monographs"* compiled by ALEXANDER AGASSIZ, WALTER FAXON, and E. L. MARK.

I.

CRUSTACEA.

BY WALTER FAXON.

[It is proposed to issue in the Memoirs of the Museum a "Selection from Embryological Monographs," which will give to the student, in an easily accessible form, a more or less complete iconography of the embryology of each important group of the animal kingdom. This selection is not intended to be a handbook, but rather an atlas to accompany any general work on the subject.

The plates will be issued in parts, as fast as practicable, each part covering a somewhat limited field. The parts devoted to Echinoderms, Acalephs, and Polyps are well advanced, and a beginning has been made for the Crustacea. Occasional appendices may be published, to prevent the plates from becoming antiquated.

The quarto illustrations will be accompanied by a carefully prepared explanation, and by a bibliography, in octavo, to be made as complete as possible. Although a large part of this bibliographical literature may be found in the general works of Kölliker, Balbiani, and Balfour, and in some of the more recent special monographs, a fuller list on special subjects, comprising the scattered references now accessible only with much cost of time and labor, will be convenient for students.

The present Bulletin contains the first instalment of this bibliography. It will be followed at an early date by similar lists for the Echinoderms, the Acalephs, the Polyps, and the Fishes.

ALEXANDER AGASSIZ.

THE embryological literature of the Arthropod groups *incertæ sedis*, viz. *Xiphosura*, *Trilobita*, and *Pycnogonida*, will be found at the end of this list. An asterisk (*) before a title denotes that the work cited has not been seen by me.

December 3, 1881.

W. F.]

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(*Zoëa* of *Porcellana* (*Polyonyx*) *macrocheles* recorded from Newport, R. I.)

Instinct ? in Hermit Crabs. *Amer. Journ. Sci. & Arts* [3], X. pp. 290, 291. Oct. 1875.

(Habits of young.)

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(Eggs of *Pinnotheres*, p. 67, Pl. XXII. Development of *Palæmon*, pp. 67, 68, Pl. III. *Cumæ* the young of *Palæmon*, *Hippolyte*, and *Mysis*, p. 68.)

Zoölogical Notes from the Correspondence of Prof. Agassiz. *Amer. Journ. Sci. & Arts* [2], XIII. pp. 425, 426, 1852; XXII. pp. 285, 286, 1856.

(Cumæ the young of *Crangon*, *Palæmon*, and *Hippolyte*.)

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(On the development of the young, pp. 55, 56.)

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Xantho floridus, *X. rivulosus*, *Pilumnus hirtellus*, *Polybius Henslowii*, *Portunus puber*, and several others hatched as zoëæ.)

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(Larva referred to *Phyllosoma* by GERSTAECKER, *Arch. f. Naturgesch.* 1858, 2, p. 455.)

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(*Uca Cunninghami* Bate with live, fully developed young ones under the pleon.)

Czerniavsky. See Tscherniawsky.

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(*Passim*.)

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(Metamorphoses, pp. 8-28.)

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De Filippi. *See* Filippi.

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(*Cirripedia*.)

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(Zoëæ, pp. 372-378, Taf. XXIX., XXX.)

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(*Palæmon*, *Crangon*.)

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(*Carcinus Mænas*.)

Dujardin, Félix.

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Duthiers. See Lacaze-Duthiers.

Edwards. See Milne Edwards.

Erdl, M. P.

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(Plate II. figs. 1-10, *Carcinus Mænas in ovo*.)

Eschscholtz, Fr.

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(*Lonchophorus anceps*, col. 734, Taf. V. fig. 1, described as a Macrouran, is a Brachyuran zoëa, described by A. Dohrn, *Zeitschr. f. wissensch. Zool.*, XXI. p. 373, Taf. XXX. fig. 52, 1871, and by Claus, under the name of *Pluteocaris*, "Untersuchungen," &c., p. 65, Taf. XII. figs. 1-7, 1876.)

Faxon, Walter.

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(*Carcinus Mænas*, *Panopeus Sayi*, *Gelasimus pugnax*.)

Filippi, F. de.

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(Development, pp. 200-203, Tav. XII., XIII. figs. 10, 11.)

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(Young individuals of several species represented.)

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(Young *Cypris*, pp. 643, 644, Taf. XIX. figs. 7, 8.)

Fraisse, Paul.

Die Gattung *Cryptoniscus* Fr. Müller (*Liriope* Rathke). *Arbeit. aus dem zoolog.-zootom. Inst. in Würzburg*, IV. pp. 239-296, Taf. XII.-XV. 1878.

(Includes development. Nauplius of *Peltogaster Rodriguezii*, Taf. XV. fig. 57.)

Entoniscus Cavolinii n. Sp., nebst Bemerkungen über die Umwandlung und Systematik der Bopyriden. *Arbeit. aus dem zoolog.-zootom. Inst. in Würzburg*, IV. pp. 382-440, Taf. XX., XXI. 1878.

Frey (Heinrich) and Leuckart (Rudolph).

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(Development of *Mysis*, pp. 127-130.)

Frič. See Fritsch.

Fritsch, Anton.

Ueber das Vorkommen von *Apus* und *Branchipus* in Böhmen. *Verhandl. d. Kais.-Königl. zoolog.-botan. Gesell. in Wien*, XVI. pp. 557-562. 1866.

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(Development, pp. 122, 123, Taf. VIII figs. 15-21.)

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Germ. transl. by J. A. E. GOEZE. Abhandlungen zur Geschichte der Insekten. Bd. VII. Nürnberg, 1783. Pp. 164-181, Pl. XXVII.-XXX.

(Larvæ of *Cludocera*, *Copepoda*, *passim*.)

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(On development.)

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(Egg of *Sacculina*.)

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Notice by C. SPENCE BATE in *Rec. Zoölog. Lit.* (1865), II. pp. 321, 322. 1866.

(*Phyllosoma* the young of *Palinurus*. Embryonic skin with invaginated spines in numerous genera.)

Métamorphoses des Crustacés marins. Deuxième Note. *Comptes Rendus de l'Acad. des Sci., Paris*, LX. pp. 74-77. 1865. *Rev. Mag. Zool.* [2], XVII. pp. 83-87. 1865. *Ann. Mag. Nat. Hist.* [3], XV. pp. 356-358. 1865.

(Internal structure of *Phyllosoma* and other larvæ.)

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(*Porcellana, Homarus, Phyllosoma, Nymphon*, &c.)

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(Conclusions from observations recorded in three preceding notes.)

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(Larva of *Palinurus*, described by R. Q. COUCH (*Nat. Hist. Rev.* IV., *Rep. Brit. Assoc. Adv. Sci.* for 1857), referred to *Phyllosoma*.)

Vol. V. (Arthropoda) of BRONN's *Klassen und Ordnungen des Thier-Reichs*. Leipzig und Heidelberg, 1866 et seqq.

(Development, *passim*.)

[On *Ornitholepas australis* Targ. Tozz.] *Sitzb. Ber. Gesell. naturf. Freunde zu Berlin*, 1875, pp. 113-115.

(An immature form. See AD. TARGIONI TOZZETTI, *Bull. Soc. Entomol. Italiana*, IV. pp. 84-96, Tav. I. 1872.)

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(Nauplius of *Ophioseides apoda*, Pl. XIX. fig. 2.)

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("Nauplius-eye" in embryo.)

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(Development, pp. 693-698. On the eye of *Cypris*-larva of *Cirripedia*, p. 695, foot-note.)

On the Nauplius and Pupa Stage of *Suctorina*. *Ann. Mag. Nat. Hist.* [5], II. pp. 233, 234. Sept. 1878.

(Fritz Müller's "*Peneus-nauplius*" not a larval Suctorian.)

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(Young of *Cyclops* and *Cypris*.)

Goodsir, Henry D. S.

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(Young of *Hyperia* [?], p. 368, Pl. XXII. fig. 15.)

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Cf. BELL'S *Hist. Brit. Stalk-eyed Crustacea*, Introd., p. xlv. London, 1853.

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(*Praniza*, *Anceus*, and parasitic *Copepoda*.)

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(Embryos of some species parasitic in Ascidians.)

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(Includes observations on development.)

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plément du 3^e Art. Crustacés parasites vivant dans les Ascidies Phallu-

siennes. 5^e Art. Genre Pleurocrypte, Nobis. *Ann. Sci. Nat.* [5], Zool.,

III. pp. 221-242, Pl. IV. 1865.

Abstr. by W. S. DALLAS in *Ann. Mag. Nat. Hist.* [3], XVI. pp. 162-167. 1865.

(Young of *Notopterophorus bombyx*, pp. 225, 226; *Pleurocrypta Galatea*, pp. 233-235, Pl. IV. figs. 18-28.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

6^e Art. *Ann. Sci. Nat.* [5], Zool., IV. pp. 229-258, Pl. VI., VII. 1865.

(Young of several species found parasitic in compound Ascidians.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

7^e Art. Mémoire sur un nouveau Crustacé parasite appartenant à l'Ordre

des Lernéidiens, formant la Famille des Lernéosiphoniens et le Genre Leposiphile. *Ann. Sci. Nat.* [5], Zool., V. pp. 265-279, Pl. IX. 1866.

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(Larva, pp. 269, 270, figs. 23-26.)

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9^e Art. Recherches sur les Genres Doropygus et Dyspontius de M. Thorell.

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mopache et Platydurax (Nobis). *Ann. Sci. Nat.* [5], Zool., VI. pp. 51-87, Pl. IV. 1866.

(Young of *Doropygus*, a parasite of Ascidians, pp. 57, 65.)

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10^e Art. Peltogastres et Sacculinidiens. *Ann. Sci. Nat.* [5], Zool., VI.

pp. 321-360, Pl. XI., XII. 1866.

(Includes observations on development.)

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11^e Art. Mémoire concernant deux Crustacés nouveaux trouvés parmi des

Ballanes sillonnées (*Balanus sulcatus*) et des Anatifes lisses (*Anatifa laevis*).

Ann. Sci. Nat. [5], Zool., VII. pp. 123-152, Pl. II., III. 1867.

(Includes observations on larvæ of *Cirripedia*.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

14^e Art. Description de deux Sacculinidiens, d'un Peltogastre, d'un

Polychliniophile et de deux Cryptopodes nouveaux. *Ann. Sci. Nat.* [5],

Zool., VIII. pp. 377-381, 1867; IX. pp. 53-61, 1868.

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15^e Art. Description d'un nouveau Crustacé appartenant au Genre Limnorie. *Ann. Sci. Nat.* [5], Zool., X. pp. 101-120, Pl. IX. 1868.

(Young, pp. 108, 109, figs. 4, 5.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

16^e Art. *Ann. Sci. Nat.* [5], Zool., X. pp. 347-371, Pl. XIX. 1868.

(Embryo of *Cuma terginigra*, pp. 353, 354, fig. 19.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

17^e Art. Description d'un nouveau Crustacé Type d'une nouvelle Famille des Annelidicoles; du Genre des Chelonidiformis; du nouveau Genre Aplopode et de plusieurs autres Crustacés, encore inédits, appartenant aux Genres Polychliniophile, Cryptopode, Botryllophile, Bothacus, Adranesius, Lygephile et Doropygus. *Ann. Sci. Nat.* [5], Zool., XI. pp. 275-308. 1869.

(Observations on young, *passim*.)

Observations sur des Crustacés rares ou nouveaux des Côtes de France.

18^e Art. Description d'une nouvelle Espèce de Crustacé parasite des l'Ordre des Lernéidiens de la Famille des Lernéoceriens, et du Genre Lernée: Lernée du Gade-petit, *Lernæa Gadni minutus* [*Gadi minuti*] (Nobis). *Ann. Sci. Nat.* [5], Zool., XIII., Art. 4. 30 pp., Pl. I. 1870.

(Embryology, pp. 7-15, Pl. I.)

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21^e [20^e] Art. Mémoire sur la Famille des Sphéromiens, à l'Occasion des Affinités et des Relations sexuelles qui paraissent exister entre les Sphéromiens et les Cymodocéens d'une part, et les Dynaméniens et les Néséens d'autre part. *Ann. Sci. Nat.* [5], Zool., XVII., Art. 1. 35 pp., Pl. I.-III. 1873.

(Treats of young, *passim*.)

Mémoire sur des Crustacés rares ou nouveaux des Côtes de France.

21^e Art. Description de Crustacés nouveaux appartenant à la Légion des Edriophthalmes, de l'Ordre des Amphipodes, de la Famille des Piscicoles, de la Tribu des Enoplopodes, Nobis, du Genre des Ichthyomyzoques, Nobis. *Ann. Sci. Nat.* [5], Zool., XVII., Art. 7. 16 pp., Pl. IV. 1873.

(Young of *Ichthyomyzocus Lophii* resembles adult, p. 11.)

Observations biologiques concernant les Cymothoadiens parasites et notamment le Cymothoé (Estre, *Cymothoa Estrum*. *Revue des Sci. Nat.*, II.

pp. 1-13. June, 1873.

(Remarks on the young.)

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(Includes young or *Praniza* state.)

Remarques sur le Genre *Chalime*. *Ann. Sci. Nat.* [6], Zool., V., Art. 10. 3 pp. 1877.

(This so-called genus is a larva.)

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Description des Crustacés rares ou nouveaux des Côtes de France décrits et peints sur des Individus vivants. 29^e Art. Description de dix nouveaux Crustacés, dont sept appartiennent du Genre *Cycnus* de Kroyer et trois au Genre *Kroyeria* de Van Beneden, tous décrits et dessinés sur des Individus vivants. *Ann. Sci. Nat.* [6], Zool., VIII., Art. 11. 34 pp., Pl. XIX.–XXI. 1879.

(Larva of *Kroyeria*, a parasitic Copepod, Pl. XXI. fig. 10.)

Description des Crustacés rares ou nouveaux des Côtes de France décrits sur des Individus vivants. 30^e Art. Description d'un nouveau Crustacé parasite appartenant à la Sous-Classe des Crustacés suceurs, de l'Ordre des Lernéides, formant la nouvelle Famille des Lernéopalmiens et le nouveau Genre des *Stylophores*, décrits et dessiné d'après des Individus vivants. *Ann. Sci. Nat.* [6], Zool., VIII., Art. 15. 16 pp., Pl. XXVIII. 1879.

(Young of *Stylophorus hippocephalus*, p. 6, figs. 22–25.)

Hoek, P. P. C.

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94 pp., 2 pl. (Inaugural Dissertation.)

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Hosius, A.

Ueber die *Gammarus*-Arten der Gegend von Bonn. *Arch. f. Naturgesch.* 1850,
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(Young, pp. 243 et seq., figs. 23, 24.)

Huxley, Thomas H.

Lectures on General Natural History. Lecture XI. *The Medical Times and Gazette*, new ser., XIV. pp. 638, 639, fig. 1. June 27, 1857.

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and *A Manual of the Anatomy of Invertebrated Animals*, pp. 350-355, fig.
79, London, 1877.

(Development of *Mysis*.)

On the Agamic Reproduction and Morphology of *Aphis*, Pt. II. § 2. Embryogeny of *Mysis*, as exemplifying the *Crustacea*. § 3. Embryogeny of *Scorpio*, as exemplifying the *Arachnida*. § 4. Generalizations regarding the Embryogeny of the *Articulata*, and Morphological Laws based on them. § 5. The Embryogeny of *Articulata*, *Mollusca*, and *Vertebrata* compared. *Trans. Linn. Soc. London*, XXII., Pt. III. pp. 225-234. 1858.

The Crayfish. An Introduction to the Study of Zoölogy. London and New York, 1880. 371 pp., 81 cuts.

(Development, pp. 39-44, 205-226, figs. 8, 57-60.)

Joly, N.

Histoire d'un petit Crustacé (*Artemia salina* Leach), auquel on a faussement attribué la Coloration en Rouge des Marais salants Méditerranéens, suivie de Recherches sur la Cause réelle de cette Coloration. *Ann. Sci. Nat.* [2], Zool., XIII. pp. 225-290, Pl. VII., VIII. 1840.

(Development, pp. 257-262, Pl. VII.)

Also printed with the same title at Montpellier, 1840. 72 pp., 3 pl.

Recherches Zoologiques, Anatomiques et Physiologiques sur l'*Isaura cycladoïdes*, nouveau Genre de Crustacé à Test bivalve, découvert aux Environs de Toulouse. *Ann. Sci. Nat.* [2], Zool., XVII. pp. 293-349, Pl. VII.-IX. A. 1842.

(*Estheria*. Development, pp. 321-330, Pl. IX. A.)

Sur les Métamorphoses d'un Crustacé de la Tribu des Salicoques, trouvé dans le Canal du Midi. *Comptes Rendus de l'Acad. des Sci., Paris*, XV. pp. 36, 37. 1842.

(*Caridina Desmarestii*.)

Études sur les Mœurs, la Développement et les Métamorphoses d'une petite Salicoque d'Eau douce (*Caridina Desmarestii*), suivies de quelques Réflexions sur les Métamorphoses des Crustacés Décapodes en général. *Ann. Sci. Nat.* [2], XIX. pp. 34-86, Pl. III., IV. 1843.

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Jurine, Louis.

Mémoire sur l'Argule foliacé (*Argulus foliaceus*). *Ann. du Mus. d'Hist. Nat.*, VII. pp. 431-458, Pl. XXVI. 1806.

(Development, pp. 452-456.)

Histoire des Monocles qui se trouvent aux Environs de Genève. Genève, 1820. 258 pp., 22 pl.

(Young of *Copepoda*, *Cladocera*, *Ostracoda*, *passim*.)

Translation of the Memoir of SHÄFFER, Sur les Monocles à queue, ou Puces d'Eau rameuses, pp. 181-197.

(Development, pp. 196, 197.)

Mémoire sur le Chirocéphale. Par BÉNÉDICT PREVOST, pp. 201-244, Pl. XX.-XXII.

(Development, pp. 214-220.)

Kellicott, D. S.

A Larval Argulus. *The North American Entomologist*, I. pp. 57-60, Feb. 1880.

Kinahan [John Robert].

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(*Balanus*.)

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III. Die Abhängigkeit der Embryonal-Entwicklung vom Fruchtwasser der Mutter. Pp. 176-211.

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Beneden. See Van Beneden.

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(*Limulus* from the Philippine Islands has a free-swimming nauplius larva, p. cxxxii.)

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(*Limulus rotundicaudatus* does not have a direct development like *L. Polyphemus* but has a nauplius larva, pp. 157, 158. [Letter to Professor Kupffer.])

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No. 11. — *On some Young Stages in the Development of Hippa, Porcellana, and Pinnixa.* By WALTER FAXON.

I. *Hippa talpoida*.

DURING the month of August, 1877, I procured large numbers of *Hippa talpoida* on the bathing-beach near Nobska Point, Wood's Hole, Massachusetts, the locality made known by Professor S. I. Smith. Among them were many ovigerous females, from which I obtained the first stage of the larva. As a supplement to Professor Smith's paper on the early stages of this animal,* I present the following description and figures of the first zoëa-stage, Smith's series beginning with what he presumes to be the second zoëa-stage.

The carapace (Plate I. Figs. 5, 6, 15) is oval, smooth, strongly convex above, curving downward and inward on the sides. It sends a long blunt process forward below the eye-stalks (Plate I. Fig. 6 *b*). Behind, it presents a deep sinus for the accommodation of the abdomen (Plate I. Fig. 15 *b*). Anteriorly it is produced between the eye-stalks into a short, broad, rather blunt rostrum. The carapace has no dorsal or lateral spines. At the points where the lateral spines appear after subsequent moults, there is a thickening of the integument, producing a very slight bulge on the outer surface, a stronger one within (Plate I. Fig. 15 *a*).

The abdomen has nearly the same form as in the later stages of the zoëa. It consists of but five segments, counting the telson. The first abdominal segment of the adult is fused with the second or with the thorax, the sixth with the telson. The fourth segment in the abdomen of the larva is considerably wider behind than in front. The telson is quite different from the telson as seen in Smith's figures of the later stages. Its breadth now slightly exceeds its length, and the curve of the sides is such that nearly the maximum width is reached but a short distance from the anterior border. From the middle it narrows slightly posteriorly, to be produced at the posterior angles into a stout tooth. As in the later stages, the convex posterior margin of the telson is furnished with spines and minute teeth (Plate I. Figs. 13, 14). The number of spines is the same as in the later stages, namely, twenty-six, the eighth, counting from either side, being the longest; but the number of denticles between the spines is much less than in the later stages. Starting with the single median denticle, the spines are separated by single denticles until the tenth spine is

* The Early Stages of *Hippa talpoida*, with a note on the Structure of the Mandibles and Maxillæ in *Hippa* and *Remipes*. By Sidney I. Smith. Trans. Conn. Acad. III. pp. 311–342; Pl. XLV. – XLVIII. 1877.

reached on either side ; the three following interspaces contain two denticles ; the wider space between the outer spine on either side and the lateral tooth gives room for four denticles. Thus we have thirty-nine denticles in all, in place of about one hundred in the stage described by Smith as the second. There is no vestige of appendages upon any of the abdominal segments.

The first pair of antennæ (Plate I. Fig. 8) are nearly as in the earliest stage as described by Smith ; but in some specimens I detected the rudiment of the secondary flagellum in the shape of a small tubercle at their base (*a*). On this point, however, there may be some doubt, as the secondary piece does not appear, according to Mr. Smith's observations, until the megalopa-stage is reached.

In the second pair of antennæ (Plate I. Fig. 9) the rounded prominence which represents the rudimentary flagellum in the "second" stage of the zoëa is so slightly developed as to be scarcely discernible (*c*).

The labrum (Plate I. Fig. 6 *a*) is enormously developed, and seems to be almost prehensile when one watches the motions of the living animal. The oral appendages and the first and second pairs of maxillipeds (natatory legs) (Plate I. Figs. 5, 6, 10-12) are similar in structure to those of the youngest stage observed by Professor Smith ; the outer lobe of the first pair of maxillæ (Plate I. Fig. 11 *b*), however, has but two slender teeth instead of three, as in the later stage, and the outer branches of the natatory legs (Plate I. Figs. 5, 6) bear four long plumose setæ instead of eight. Other differences will be most readily seen by comparing my figures with Professor Smith's. There is no trace of any appendages back of the second maxillipeds.

Length, including the abdomen, about 1 mm.

The heart is plainly visible through the transparent carapace, on the dorsal side of the cephalo-thorax. It has the form of a large, irregular pentagon, lying within a lozenge-shaped pericardial sac, with which it is connected by six delicate threads. The pericardium itself is attached to the walls of the body by stronger ligaments.

The heart gives off three arteries. Of these, one proceeds from the anterior angle, in the median line of the body, in the shape of a large tube to the base of the rostrum, where it suddenly diminishes in volume, but persists as a very minute canal to the tip of the rostrum. At the base of the rostrum, just where the diminution of the median artery occurs, a large lateral tube is given off on each side, which convey the bulk of the blood from the median channel to the eye-stalks. These arteries, which might be appropriately termed the rostral and ophthalmic arteries, are together equivalent to the ophthalmic artery of the adult, the small terminal branches to the eyes in the adult being here found in the form of long and capacious vessels, in relation to the large size of the eyes and their distance apart in the larva.

From the posterior part of the heart, two arteries are given off in the middle line of the body. The upper one is small, extends backward through the abdomen on the dorsal side, and ends in the telson. The other has its origin at nearly the same point as the first, but plunges down to the lower face of

the body. Its further course was not determined. The two posterior vessels correspond to the superior abdominal and sternal arteries of the adult. I was unable to discover any vessels answering to the antennary and hepatic arteries of the adult.

After issuing from the ends of the arteries, the blood may be seen coursing through the cavities of the body back to the heart. Two of these currents are evident in the abdomen, one above, and the other below, the abdominal artery. The venous blood in the cephalo-thorax streams back from the head along the border of the carapace and upward to the heart. No traces of gills exist at this stage. The blood is aerated in a great measure, probably, through the thin walls of the carapace, currents of water being kept up, as in the gill-bearing adult, by the constant motion of the scaphognathite of the second pair of maxillæ.

The integument is nearly colorless and transparent, with a few blotches of bright red pigment. The largest of the pigment-spots are, one on the lower side just back of the mouth, two on the carapace at the points where the lateral spines subsequently appear, and two on the telson (one on either side of the anal opening). Beside these there are a few smaller specks of pigment on the carapace and on the second, third, and fourth segments of the abdomen.

It will be seen, from the foregoing description and from the figures, that we have the same stage of the larva as that noticed by Fritz Müller on the coast of Brazil in the case of *Hippa emerita*. Of this a brief notice and an unsatisfactory figure are given in his work "Für Darwin." * Up to the time of Smith's observations this was all there was known of the developmental history of *Hippa*. The notice is very brief: "The zoëa of the Tatuira [*Hippa emerita*] (Fig. 25) also appears to differ but little from those of the true crabs, which it likewise resembles in its mode of locomotion. The carapace possesses only a short, broad frontal process; the posterior margin of the tail is edged with numerous short setæ."

Professor Smith says: "Very nearly fully developed embryos, when removed from the egg, were found to possess all the normal articulated appendages of the fully formed zoëæ, but there was no appearance of lateral spines upon the carapax, and the rostrum was broad and obtuse. In this stage the embryo agrees almost perfectly with the figure of the zoëa of *Hippa emerita* from the coast of Brazil, given by Fritz Müller in his work entitled 'Für Darwin.' The difference between the embryo in this stage and the second zoëa-stage [i. e. the stage presumed to be the second] (Plate XLV. Fig. 1), in which the rostrum and lateral spines are enormously developed, suggests the possibility that Müller had observed only imperfectly developed young zoëæ in which the rostrum and lateral spines were not expanded. It seems scarcely probable that such a difference could exist between the first stage of the zoëa, when the veiling membrane, in which, on first escaping from the egg, the

* Für Darwin. 1864. English Translation by W. S. Dallas, pp. 53, 54; Fig. 25. 1869.

young are usually enveloped, has been entirely cast off, and the lateral spines and the rostrum are fully expanded, and the second zoëa-stage about to be described."*

As I have now shown that the first stage is really devoid of lateral spines, and has only a short and broad rostrum, it is to be inferred that the so-called "second zoëa-stage" (which was taken in the towing-net) is in reality a later one in the development.† I was unable, with the greatest care, to rear any larvæ through the first moult into the second stage, but I think that one if not more stages remain to be discovered between the first and the earliest described by Smith.

II. *Porcellana* (*Polyonyx*) *macrocheles*.

Among the interesting Crustacean larvæ which the Gulf Stream bears to the southern shores of New England from more southern latitudes, is the peculiar zoëa of *Porcellana macrocheles*. Not uncommon on the coast of the Carolinas, the adult has been found but once, as far as I know, on the coast of New England, Mr. Alexander Agassiz having detected it under stones on the shore at Newport, R. I. In the same category are the young of *Calappa marmorata* and *Ocypoda arenaria*, which are found, the former rarely, the latter quite commonly, as far north as Cape Cod, but which rarely, if ever, survive our rigorous winter.‡

* *Op. cit.*, pp. 314, 315.

† Professor Smith's "numerous attempts to obtain newly hatched young, by keeping egg-carrying females in aquaria, failed from the parent's invariably casting off the eggs before they were fully matured." (*Op. cit.*, p. 314.) By selecting females with eggs considerably advanced toward maturity, and placing them in a cool place, in shallow vessels covered at the bottom with clean sand, and renewing the water twice a day *directly from the sea*, I found no difficulty in obtaining several broods of young at various times between the 1st and 30th of August. I succeeded best by covering the sand with but a slight depth of water, and tipping up the vessel a little so that part of the sand was above water, thus imitating the natural beach, where at low tide the *Hippæ* are found in the wet sand just above the water-mark. I observed that in vessels so placed the *Hippæ* for a large part of the time preferred the wet sand above the water-line.

For the free use of the laboratory and apparatus of the United States Fish Commission at Wood's Hole, in the summer of 1877, I am indebted to Professor S. F. Baird, U. S. Commissioner of Fish and Fisheries.

‡ Professor S. I. Smith found small, young specimens of *Ocypoda arenaria* in the latter part of August and in September on Fire Island Beach, Long Island, but careful search failed to reveal a single specimen of the adult or half-grown crab. (*Amer. Jour. Sci. and Arts*, 3d Series, VI. p. 68. 1873. *Invert. Animals of Vineyard Sound*, p. 241. 1873.) No one has found the zoëa of this animal so far north, although the megalopa is not uncommon. The zoëæ of *Porcellana* which I collected at Newport were nearly all in the last stage of their development. From these facts it is highly probable that these species are not *natives* of the New England coast.

On several warm, still mornings in August, 1878, the zoëæ of *Porcellana* swarmed in the streaks of smooth water on the edge of the tidal currents at the mouth of Narragansett Bay.* They are sluggish, and move either forward or backward. The little spines with which their enormously developed rostra are armed serve to accumulate the minute particles floating in the water to such an extent that the little creatures often become quite conspicuous by virtue of the load of dirt which they carry.

Of the numerous specimens which I collected almost all were in the stage immediately preceding the youngest stage of the crab, into which they readily developed in confinement, and some of which were taken from the sea with the zoëæ.

Specimens in the last zoëa-stage (Pl. II. Fig. 1) measure about 16 mm. from the tip of the rostrum to the tips of the posterior spines of the carapace. The rostrum is 11 mm. long, the posterior spines 2.5 mm.

Viewed from the side, the carapace is of a long oval form, extending forward as an enormous rostrum, and backward into two horns curved slightly downward at their ends. The rostrum is furnished with five rows of little spines disposed as shown in the cross-section (Pl. II. Fig. 3). The posterior horns have a single row of spines below (Pl. II. Figs. 2, 4). The first pair of antennæ (Pl. II. Fig. 6) are composed of a long peduncle which is obscurely divided into two or three segments. At its base there is a slight enlargement which contains the auditory apparatus (*a*). The peduncle bears a blunt process (*b*), and a longer segment (*c*) which is furnished with several sensory threads (*d*). The second pair of antennæ consist of a two-jointed peduncle, in the basal segment of which may be seen the orifice of the renal organ (*c*). Of the two branches borne by the peduncle, the inner (*a*) is the longer, and within its transparent integument is seen the multi-articulate flagellum of the antenna of the crab, to be disclosed at the next moult. The outer branch (*b*) is styliform. The mandibles have a many-toothed crown (Pl. II. Fig. 8), and the palpus is represented by a very small protuberance (*a*).† The bilobed metastoma is armed with short setæ on the inner margin of each lobe (Pl. II. Fig. 9). The first pair of maxillæ consist of an inner lobe (Pl. II. Fig. 10 *a*) and

* I am indebted to Mr. Agassiz for the facilities for investigation afforded by his laboratory at Newport, R. I.

† Although this is certainly the last stage of the zoëa (I obtained the young crab from it after a single cast of the skin), the mandibular palpus is not developed to anything like the extent seen in Dohrn's figure of a *Porcellana* zoëa. (Untersuchungen über Bau und Entwicklung der Arthropoden. Zeits. Wiss. Zool. XXII. p. 373; Taf. XXIX. Fig. 51. 1871.) Claus, describing a *Porcellana* zoëa from Nice in a stage corresponding to the one before us (Marburger Sitzungsberichte 1867, p. 15), states that the mandibles are destitute of palpi; but in his later work "Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen Systems," 1876 (p. 58), describing the same stage, he says the rudiment of the palpus exists as a simple prominence.

an outer lobe (*b*) ; the outer lobe bears the palpus (*c*). All the parts which compose the first maxilla are furnished with plumose setæ. The second pair of maxillæ (Pl. II. Fig. 11) consist of four lobes of about equal size, a narrower lobe, and a scaphognathite (*a*) ; all of these lobes are fringed with plumose setæ on their margins.

The two pairs of swimming-feet (first and second maxillipeds) (Pl. II. Fig. 1) are very similar to each other in form. The outer branch is two-jointed, the inner branch four-jointed. The third pair of maxillipeds (Pl. II. Figs. 1, 12) are rudimentary, sac-like structures, which can hardly as yet be of much functional value. They are, however, developed so far as to project beyond the border of the carapace. The inner branch (Fig. 12 *a*) is much longer than the outer (*b*). The latter is tipped with long setæ. Through the transparent sac-like integument the segments of the outer maxilliped of the next stage may be indistinctly seen.

The five pairs of ambulatory limbs of the future crab are doubled up under the carapace (Pl. II. Fig. 1). By removing them from the body of the zoëa their whole form is seen as represented in Pl. II. Fig. 13. Through the thin investing membrane the segmentation of the limbs is quite distinctly seen as it exists in the following stage after the tegument has been thrown off. Even the hooks on the last segment of the second, third, and fourth pairs are visible (*b'*). At the base of the thoracic appendages the gills (six pairs) have already attained a considerable size (Figs. 1, 13 *f*).

The abdomen is composed of six segments. The telson (Pl. II. Fig. 5) is produced on either side into a strong tooth ; the posterior margin is very convex, scalloped, and ornamented with twelve beautiful, feather-like setæ. In specimens about to moult the telson is seen to contain the sixth abdominal segment (*b*) with its appendages (*c*, *d*), as well as the telson (*a*) of the crab. There is a pair of simple unsegmented appendages on the second, third, fourth, and fifth segments of the abdomen (Pl. II. Figs. 1, 14).

The stomach shows through the transparent carapace just back of the base of the rostrum. On either side are four lobes of the liver, two directed forward, two backward. The intestine is straight and simple, and ends in the fore part of the telson below. The heart lies under the centre of the carapace ; from its anterior angle the median artery can be traced nearly to the end of the rostrum ; the sternal artery reaches the lower floor of the thorax near the roots of the third pair of maxillipeds, passing through the great thoracic nerve-mass ; here it forks, one branch proceeding forward, giving off in its course lateral branches to the anterior appendages, the other backward to the abdomen.

The nervous system departs widely from its primitive condition even in this immature stage. The thoracic ganglia are consolidated into an enormous mass which sends nerves to the thoracic appendages. From this thoracic nerve-mass two parallel nerve-cords extend through the abdomen, binding together the ganglia, which lie one in each abdominal segment.

The integument is nearly colorless, with some spots of vermilion pigment on the basal segments of the first and second pairs of maxillipeds, on the tel-

son, and on the lower side of the cephalo-thorax. There is also vermilion in the wall of the intestine.

A few specimens were collected in a younger stage than that described above. They were somewhat smaller than the other specimens; the first pair of antennæ were simple, with three or four sensory threads at the tip; the Decapodal legs were very small buds, much more rudimentary than in the later stage; the third pair of maxillipeds were also smaller, with the inner branch much shorter in proportion to the outer branch; the four pairs of abdominal limbs were present, but of smaller dimensions; the telson displayed but ten plumose setæ on its posterior margin. In other respects they agreed pretty closely with the older individuals.

Many of the specimens in my aquaria developed from the oldest zoëa-stage directly into the first stage of the crab (Plate III. Fig. 1), described further on, in which there is not the slightest trace left of the rostrum or posterior spines of the zoëa. In one instance I detected the young crab in the very act of disengaging itself from its zoëa-case. In another young crab which had just emerged from the zoëa, the shrivelled remnant of the artery and other soft parts within the rostrum of the zoëa was still sticking to its front.

Fritz Müller was right, then, when he surmised that the oldest *Porcellana* zoëa observed by him at Santa Catharina (which was in the same stage as the oldest zoëa described above) would pass through the next moult into a form not differing essentially from the adult *Porcellana*,* although Claus thinks it probable that there is an intervening form corresponding to the youngest megalopa-stage of the *Brachyura*.†

First Porcellana-stage (Plate III. Figs. 1–10). The carapace is now about 2 mm. long; its breadth is about the same as its length. It is suborbicular in its outline, the front broad and furnished with minute hairs.

* Die Verwandlung der Porcellanen. Arch. f. Naturgeschichte, 1862, 1, p. 198.

† After describing the same stage as the oldest one observed by Müller, Claus says "Ueber die späteren Entwicklungsstadien fehlen mir leider Beobachtungen, doch wird es nach Analogie mit der Krabbenmetamorphose wahrscheinlich, dass sich noch ein Zwischenglied, etwa dem jüngsten Megalopastadium entsprechend, einschleibt. Fr. Müller bemerkt zwar, dass das mit der nächsten Häutung hervorgehende Thier kaum wesentlich von der erwachsenen *Porcellana* verschieden sei, da die Porcellanen auf die Stufe der *Megalopa* stehen geblieben sind. Indess ist dabei zu bemerken, dass es sich hier um das Endglied der Megalopaformen handelt, zu welchem auch bei den Krabben die Zoëa nicht unmittelbar, sondern durch Zwischenformen führt. (Untersuchungen, p. 59.) In reality, one sees in the young *Porcellana* no zoëa characters persisting in the shape of large eyes, form and armature of the carapace such as are found in the youngest stages of megalopæ. In these regards it is as far removed from the youngest megalopa-stage as the adult is. The abdomen, moreover, is relatively no larger than in the mature animal, and, as far as I observed, but little used as a swimming-organ. True, the abdomen is furnished with two-branched setiferous appendages (Pl. III. Fig. 10), but this is not a peculiarity of the youngest megalopa-stage of *Brachyura*: as will be seen further on in *Pinnixa*, like appendages are retained (in both sexes, apparently), even in the youngest crab-stages.

The abdomen is relatively no larger than in adult specimens, and is bent underneath against the sternum. The telson consists of a single piece, with a faint indication of the median suture of the adult. After the next moult the diagonal sutures appear (Fig. 8) and the telson assumes the polymeric character of the adult.* The posterior border of the telson is fringed with long and delicate setæ.

The first pair of antennæ (Figs. 3, 6 *b*) have an enormously developed basal (auditory) segment (Fig. 3 *a*), followed by a three-jointed peduncle bearing two flagella (*b*, *c*), of which the outer (*c*) is the longer.

The second pair of antennæ are very long (longer than in the adult), composed of about thirty-four segments.

The oral appendages have almost exactly the structure of the corresponding appendages of the adult, which are represented on Plate III. Figs. 13-18. The mandibular palpus has attained its perfect, tri-articulate structure, and is as large in relation to the size of the body of the mandible as it is in the full-grown specimens. This is remarkable when one considers its rudimentary form in the last zöëa-stage (Plate II. Fig. 8 *a*).

The chelipeds are longer than in the adult (Fig. 11). One (commonly the right) is larger than its fellow. Like the four following pairs of thoracic legs, they are beset with setæ on either border.

The ambulatory pairs are also longer than in the adult. The dactylus (Fig. 4) is armed with hooks like those in the full-grown specimens (Fig. 19), but it is much more slender.

The posterior thoracic legs are rudimentary and terminated with a didactyle claw (Fig. 5), as perfectly formed as in the adult.

The second, third, fourth, and fifth abdominal segments bear peculiar two-branched appendages (Fig. 10), furnished with long, feather-like setæ. The large number of individuals which I examined (which it is fair to presume included both sexes) showed no difference in the number and shape of the appendages of the abdomen. In the adult these appendages take on a very different form in both sexes. In the female they become one-branched, slender organs (Fig. 20), and the pair belonging to the second segment disappears.† In the male only one pair persists (on the second segment, Fig. 21); here the second branch exists as a rudiment (*a*). The series of changes through which the abdominal appendages of the young are converted into the adult form I was unhappily unable to follow. In specimens from South Carolina, 6 mm. across the carapace, the external sexual characters are already acquired.

My specimens underwent but little change, before I left Newport in Septem-

* Milne Edwards thought that the sutures in the telson of *Porcellana* showed that it was formed by a consolidation of the seventh abdominal segment with a pair of appendages belonging to the same segment (*Histoire Naturelle des Crustacés*, II. p. 249. 1837). It is plain from the development that this theory of the structure of the telson is false.

† In the adult females of many species of *Porcellana* the first, second, and third abdominal segments are destitute of appendages.

ber. Several individuals moulted once or twice, but beyond a slight increase in size, a growing opacity of the shell, and the change in the telson noticed above, little alteration was discernible.

On looking at the proportions of the adult *Porcellana macrocheles* (Fig. 11) the carapace of this specimen measured 9 mm. in length by 12.5 mm. in width) one might be inclined to doubt its identity with our young form ; but I have material at hand to show that the widening of the carapace is the gradual result of growth. In a specimen 3.5 mm. broad, caught, free-swimming, at Newport on the 30th August, 1865, by Mr. Alexander Agassiz,* of which he made a sketch at the time, the breadth of the carapace exceeds its length by one fifth. In a specimen from Charleston, S. C., 6 mm. broad, the carapace is less than one fourth broader than long.

As the delicate integument of the young becomes indurated by the deposition of calcareous salts, and the aeration of the blood devolves more and more exclusively upon the gills, the carapace broadens with the expansion of the respiratory chamber. This change in the proportions of the carapace is commonly seen in the *Brachyura* when a graduated series from very small to adult specimens is examined, and Carcinologists cannot be warned too often against establishing new species upon juvenile characters.

List of Works relating to the Development of Porcellana.

HAILSTONE and WESTWOOD. Descriptions of some Species of Crustaceous Animals.

By S. HAILSTONE, JUN., ESQ. With Illustrations and Remarks, by J. O. WESTWOOD, ESQ., F. L. S., etc. Loudon's Magazine of Natural History, Vol. VIII. pp. 261 - 277 ; Figs. 28, 29, May, 1835.

This paper contains descriptions and figures of a series of young specimens of *Porcellana* from Hastings, England (*P. minuta* Westw. ; probably the young of *P. longicornis*, M. Edw.). The smallest of these specimens measured 2 mm. in length, and was used by Westwood as an argument against the probability of a metamorphosis in *Porcellana*, which had recently been announced by J. V. Thompson.

THOMPSON, J. V. Memoir on the Metamorphosis in *Porcellana* and *Portunus*. Entomological Magazine, Vol. III. pp. 275 - 277, Fig. 1, Oct. 1835.

This is the first published notice of the zoëa of *Porcellana*.† Thompson actually

* Mr. Agassiz has another drawing of a young *Porcellana* raised from the zoëa at Newport, August 17, 1875, which seems to indicate the occurrence of a second species on the coast of New England. In this form the front is prominent and triangular, the dactyli of the ambulatory feet long and without the accessory claws of *Polyonyx*. The length of the carapace is 3 mm., its breadth slightly less.

† According to Claus, who ignores the observations of Thompson, Couch, and Dujardin (Marburger Sitzungsberichte, 1867, p. 12 ; Untersuchungen über Crustaceen, p. 57), the larva of *Porcellana* was described under the name of *Lonchophorus anceps* as early as 1825 by Eschscholtz. (Bericht über die zoologische Ausbeute während der Reise von Kronstadt bis St. Peter- und Paul. Isis von Oken. 1825, 1. col. 734 ; Taf. V. Fig. 1.) The animal here referred to, as is evident from the figure, is the *Brachyuran* zoëa afterwards described by Dohrn (Zeits. Wiss. Zool. XXI)

obtained the larvæ of one of the British species from the eggs, and gives a rude figure of the first stage of the zoëa.

COUCH, R. Q. "On the Metamorphosis of the Decapod Crustaceans. Ann. Rep. and Trans. Cornwall Polytechnic Society, 1843."

An account of Couch's observations (I have not been able to see the original paper) is given in Bell's "History of the British Stalk-eyed Crustacea," Introduction, pp. lv-lvii, Figs. *f, g, h*. 1853. Couch reared the larvæ of *Porcellana platycheles* from the egg, but it is difficult to understand his confused account and figures as reproduced by Bell. It appears as if Fig. *f*, which is said to represent the larva on its first escape from the egg, must represent one prematurely extracted from the egg while still clad in the intra-oval veiling membrane, with the rostrum folded under the breast.

DUJARDIN, FÉLIX. Observations sur les métamorphoses de la *Porcellana longicornis*, et description de la Zoë, qui est la larve de ce crustacé. Comptes Rendus, XVI. pp. 1204-1207. 1843.

First stage of zoëa, obtained from the eggs. *The horns of the carapace are described as segmented.*

DANA, J. D. United States Exploring Expedition. Crustacea. Pp. 684, 685. Pl. 45, Fig. 12. 1852.

Dana's *Zoëa longispina*, taken in the Sooloo Sea, Feb., 1842, is doubtless the larva of a *Porcellana*.

MÜLLER, FRITZ. Die Verwandlung der Porcellanen. Archiv für Naturgeschichte, 1862, 1, pp. 194-199; Taf. VII.

—— Für Darwin, 1864. (Eng. Trans. p. 53, Fig. 24. 1869.)

Müller observed the zoëæ of three species at Desterro, Brazil, in two stages of development. His first stage, with simple first antennæ and lack of appendages back of the second maxillipeds, is probably the earliest stage of the zoëa after quitting the egg. The second form is doubtless the last zoëa-stage, as Müller himself suspected, although he did not rear it into the *Porcellana*. Müller did not fail to see the Brachyuran character of the development of *Porcellana*.

CLAUS, CARL. Ueber den Entwicklungsmodus der Porcellana-Larven im Vergleiche zu den Larven von Pagurus. Sitzungsberichte der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg. 1867, pp. 12-16.

—— Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen-Systems, pp. 57-59; Taf. VII. Figs. 1-13. 1876.

Describes zoëæ from the Mediterranean Sea and the Atlantic Ocean in three developmental stages. In the second of these stages the first antennæ are still unsegmented, the third maxilliped and the five pairs of ambulatory limbs exist in the shape of six pairs of short sacs. This is apparently a younger stage than the earliest observed by me, in which the abdominal legs have already appeared. Claus' first and third stages are the earliest and last zoëa-stages (see above, p. 259).

DOHRN, ANT. Untersuchungen über Bau und Entwicklung der Arthropoden.

11. Zweiter Beitrag zur Kenntniss der Malacostraken und ihrer Larvenformen.

Zeits. Wiss. Zool. XXI. pp. 372, 373; Taf. XXIX. Figs. 48-51. 1871.

p. 373; Taf. XXX. Fig. 52, 1871), and by Claus himself under the name of *Pluteocaris* (Untersuchungen über Crustaceen, p. 65; Taf. XII. Figs. 1-7)! Claus' reference, moreover, is incorrectly "Froriep's Notizen" instead of "Isis."

III. *Pinnixa*.

As long ago as 1835 the zoëa of *Pinnotheres* was raised from the egg and figured by J. V. Thompson.* Although this was one of the earliest known cases of metamorphosis among the *Crustacea*, Thompson's memoir has remained the sole contribution to the developmental history of the *Pinnotheridæ* up to the present time.

In the latter part of August, 1878, a large zoëa was not uncommon in Narragansett Bay, which developed in the aquarium into a species of *Pinnixa*. The development of this species is remarkable for the complete suppression of the megalopa-stage, the zoëa figured on Plate IV. (Figs. 5-15) passing directly into the first stage of the crab, represented on Plate V.

In the last zoëa-stage (Plate IV. Figs. 5-15) the carapace is armed with long frontal, dorsal, and lateral spines. The natatory feet are very short in proportion to the size of the body, the inner branch of the second pair (Fig. 11, *a*) rudimentary, as usual with Brachyuran zoëæ. The third pair of maxillipeds and the five following pairs of thoracic feet are folded under the carapace. On dissecting them out from the body, they are seen to be quite perfectly formed, as shown by Fig. 7. The third maxillipeds (Fig. 8) possess their three constituent parts (*a*, *b*, *c*) and a gill (*d*) at their base.

The abdomen (Fig. 10) is short, its penultimate segment expanded laterally into two lobes, which extend backward on each side of the terminal segment.† The terminal segment is ovate, produced posteriorly into a long spine on either side. Between the lateral spines and a small median sinus are three short, finely feathered setæ on either side.

There are four pairs of simple abdominal appendages.

There is a black pigment spot at the base of the dorsal spine, one near the base of each of the lateral spines, and several on the abdominal somites.

From tip of frontal spine to posterior border of carapace, 2.5 mm. From tip to tip of lateral spines, 2 mm. Length of frontal spine, 1 mm.

In the first crab-stage (Plate V.), which immediately follows the last zoëa-stage just described, the carapace measures less than 1 mm. in length by 1.5 mm.

* Memoir on the Metamorphosis and Natural History of the *Pinnotheres* or Pea-Crabs. By W. [J. V.] THOMPSON, F. L. S. Entomological Magazine, Vol. III. pp. 85-90. Figs. 1, 2. April, 1835.

† This peculiarity is also seen in the undetermined zoëa, figured by Claus, "Untersuchungen," etc. Taf. XIV. Figs. 1, 2 (p. 65). The abdomen of the zoëa of *Pinnotheres pisum* apparently has a like form, judging from Thompson's rude figures (*l. c.*), in which the penultimate and ultimate segments are represented as a single piece.

In "Für Darwin" Fritz Müller figures the tail of a *Pinnotheres* (Fig. 19). It has the shape generally seen in Brachyuran zoëæ, while Fig. 22, "of unknown origin," represents a tail like that of *Pinnixa* and Thompson's *Pinnotheres*. Is there no confusion here?

in breadth. The front is nearly straight, the branchial regions expanded laterally so as to form a prominent shoulder at the point where they meet the hepatic areas. A row of small, irregularly disposed spines on the sides of the carapace. The second and third pairs of maxillipeds (Figs. 6, 7) have the same structure as in adult *Pinnixa*, the terminal segment of the inner limb being articulated with the penultimate segment near the proximal end of the latter, in such a fashion as to form a sort of didactyle claw.

The cheke are didactyle, the dactylus closing against a long process of the antecedent segment. The following pairs of ambulatory appendages are extremely long, the last pair being much smaller than the rest, as in the adults of this genus.

The abdomen is small, closely folded against the sternum, and not used as a swimming organ. It carries four pairs of appendages (Fig. 3), which consist of a basal segment which supports two branches. The outer branch is much larger than the inner, and bears about nine setæ on its border. The telson is broader than long, its posterior margin regularly convex and fringed with setæ.

Blotches of dark pigment, of dendritic forms, occur on the carapace, sternum, and abdomen, arranged as represented in Figs. 1, 2.

The young crabs underwent hardly any change during my stay at Newport, and it is impossible to determine to which of the several species of *Pinnixa*, described from the eastern coast of the United States, these immature specimens belong. According to Smith, the only species found on the New England coast is *Pinnixa cylindrica* White.* I found no adult specimens at Newport.

Since the above account was prepared, I have received, through the courtesy of Professor Smith, a pair of adult *Pinnixa* from Buzzard's Bay, Massachusetts, and a few zoëæ "hatched at Noank, Connecticut, August 3, 1874, from eggs of a specimen apparently exactly like the adults sent." I identify the adults with *Pinnixa chatopterana* Stimpson † (Plate V. Fig. 8, chela of male; Fig. 9, chela of female). The zoëæ (Plate IV. Figs. 1-4) are less than a millimeter in length. The spines of the carapace are proportionately shorter than in the older zoëæ described above, the swimming-feet and abdomen longer. The appendages back of the second pair of maxillipeds are wanting. The abdomen is very like the abdomen in the older zoëæ, but has a small, triangular, terminal piece (Fig 2 b) between the setæ of the telson.

Professor Smith informs me that he observed, in 1875, the direct change

* Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters, with an Account of the Physical Features of the Region. By A. E. Verrill and S. I. Smith. In Baird's Report on the Condition of the Sea-Fisheries of the South Coast of New England in 1871 and 1872, p. 546. 1873.

† Notes on North American *Crustacea* in the Museum of the Smithsonian Institution. No. II. Ann. Lyc. Nat. Hist. N. Y. Vol. VII. p. 235. 1862.

from the zoëa to the crab in the species described in this paper, and that he had, besides, another zoëa, apparently distinguished from mine only by its slightly smaller size and shorter spines, which passed into a megalopa phase ! In this stage (a tracing of which is enclosed in Professor Smith's letter) the carapace is broad and crab-like, without a vestige of the spines of the zoëa. This megalopa subsequently changed into a young crab very nearly like that which developed *immediately* from the long-spined zoëa.*

It would seem, therefore, that two species of *Pinnixa* occur, at least in the young stages, on the southern shore of New England, which present a remarkable difference in their development. While the one goes through the customary megalopa condition, the other passes, by a syncopated development, from the zoëa directly into the brachyurous state.

CAMBRIDGE, January, 1879.

EXPLANATION OF THE PLATES.

NOTE. I am greatly indebted to my brother, Mr. Charles E. Faxon, for preparing my drawings for the heliotypic process.

PLATE I. *Hippa talpoida*.

- Fig. 1. Cluster of segmented eggs taken from the abdominal appendages of a female. The eggs are spherical, about 1.5 mm. in diameter, of a bright orange-yellow color.
- Fig. 2. Egg with the enclosed embryo in the "nauplius-stage": *a*, labrum; *b*, antenna of the first pair; *c*, antenna of the second pair; *d*, mandible; *e*, abdomen; *f*, yolk.
- Fig. 3. Embryo further advanced: *a*, rostrum; *b*, cephalic plate; *c*, antenna of first pair; *d*, antenna of second pair; *e*, mandible; *f*, first maxilla; *g*, second maxilla; *h*, first maxilliped; *i*, second maxilliped (even at this early stage, the appendages back of the mandible are double); *k*, abdomen (the likeness of the abdomen in this embryonic stage to the abdomen of prawn-zoëæ is suggestive).
- Fig. 4. The same, from a different point of view: *a*, antenna of first pair; *b*, antenna of second pair; *c*, mandible; *d*, first maxilla; *e*, second maxilla; *f*, first maxilliped; *g*, second maxilliped; *h*, hind border of carapace.

* Professor Smith has also kindly sent me tracings of the zoëa of *Pinnotheres muticatus* raised from eggs. It has a long dorsal spine (wholly wanting in Thompson's figures of the zoëa of *Pinnotheres pisum*), and the abdomen is like that figured by Fritz Müller as *Pinnotheres*, "Für Darwin," Fig. 19 (*v. supra*, p. 263, note †). Altogether the zoëa bears less resemblance to the zoëa of *Pinnotheres pisum*, as represented by Thompson, than the zoëa of *Pinnixa* does ! It should be noted that the accuracy of Thompson's figures is attested by Bell ("British Stalk-eyed Crustacea," p. 125).

- Fig. 5. First zoëa-stage.
- Fig. 6. The same, viewed from below : *a*, labrum ; *b*, process of the carapace extending forward under the eyes ; *c*, mandible ; *d*, metastoma ; *e*, first maxilla ; *f*, outer branch of first maxilliped ; *g*, inner branch of first maxilliped ; *h*, outer branch of second maxilliped ; *i*, inner branch of second maxilliped ; *k*, anus ; *l*, telson.
- Fig. 7. Eye-stalk and eye of the same stage.
- Fig. 8. First antenna of the same : *a*, rudiment of the secondary flagellum ?
- Fig. 9. Second antenna of the same : *a*, *b*, dentiform processes ; *c*, rudiment of the future flagellum.
- Fig. 10. Mandible.
- Fig. 11. First maxilla : *a*, inner lobe ; *b*, outer lobe ; *c*, palpus.
- Fig. 12. Second maxilla : *a*, inner lobe ; *b*, scaphognathite.
- Fig. 13. Posterior border of the telson ($\frac{1}{2}$ in. obj.). The arrow indicates the median line of the telson.
- Fig. 14. A spine and two adjacent denticles of the same, more highly magnified ($\frac{1}{10}$ in. obj.).
- Fig. 15. Posterior part of the carapace, viewed from behind and below : *a*, thickening of the integument at the point where the lateral spines appear in later stages of the zoëa ; *b*, abdominal sinus.

PLATE II. *Porcellana (Polyonyx) macrocheles*.

Last zoëa-stage.

- Fig. 1. Lateral view of the zoëa.
- Fig. 2. Posterior portion of the carapace from below.
- Fig. 3. Cross-section of the rostrum.
- Fig. 4. Cross-section of one of the posterior horns of the carapace.
- Fig. 5. Telson : *a*, the antecedent abdominal segment ; *b*, the sixth abdominal segment of the next stage, showing through the integument of the zoëa ; *c*, *d*, *e*, the inner and outer branches of the last abdominal appendages and the telson of the next stage showing through the telson of the zoëa.
- Fig. 6. First antenna : *a*, swelling at the base for the lodgment of the auditory organ ; *b*, inner branch ; *c*, outer branch ; *d*, sensory hairs on the outer branch.
- Fig. 7. Second antenna : *a*, internal branch (the annuli of the flagellum of the antenna of the next stage are seen within) ; *b*, external branch ; *c*, outlet of the "green gland."
- Fig. 8. Mandible : *a*, rudiment of the palpus.
- Fig. 9. Metastoma.
- Fig. 10. First maxilla : *a*, inner lobe ; *b*, outer lobe ; *c*, palpus.
- Fig. 11. Second maxilla : *a*, scaphognathite.
- Fig. 12. Third maxilliped : *a*, internal branch ; *b*, external branch.
- Fig. 13. The five following pairs of appendages (Decapodal legs) as they appear when removed from under the carapace of the zoëa : *a*, cheliped ; *b*, *c*, *d*, *e*, ambulatory pairs ; *f*, gills. The chelæ of the first and fifth pairs

and the hooks on the terminal segment of the intervening three pairs (from which the genus *Polyonyx* takes its name) are seen through the outer, investing membrane.

- Fig. 14. One of the abdominal appendages : *a*, the appendage to be disclosed at the next moult.

PLATE III. *Porcellana* (*Polyonyx*) *macrocheles*.

Figs. 1-10. First stage of the crab.

Fig. 2. One of the minute hairs of the front, highly magnified.

Fig. 3. First antenna : *a*, basal (auditory) segment ; *b*, inner branch ; *c*, outer branch.

Fig. 4. Terminal segment of one of the ambulatory limbs.

Fig. 5. Chela of the last thoracic appendage.

Fig. 6. View from the front : *a*, eye ; *b*, first antenna ; *c*, second antenna ; *d*, carapace ; *e*, basal segment of cheliped.

Fig. 7. Abdomen.

Fig. 8. Telson, after the first moult.

Fig. 9. Third maxilliped : *a*, inner branch ; *b*, outer branch ; *c*, gill.

Fig. 10. Appendage of fifth abdominal segment, right side from beneath : *a*, inner branch ; *b*, outer branch. Similar appendages are found on the second, third, and fourth abdominal segments.

Figs. 11-21. Adult specimen from South Carolina.

Fig. 12. First antenna of the right side, from below : *a*, basal (auditory) segment ; *b*, inner branch ; *c*, outer branch.

Fig. 13. Left mandible, seen from beneath : *a*, palpus.

Fig. 14. First maxilla of the left side, seen from beneath : *a*, inner lobe ; *b*, outer lobe ; *c*, palpus.

Fig. 15. Second maxilla of the left side, seen from beneath : *a*, scaphognathite.

Fig. 16. First maxilliped of the left side, seen from beneath.

Fig. 17. Second maxilliped of the left side, seen from beneath : *a*, inner branch ; *b*, outer branch.

Fig. 18. Third maxilliped of the left side, seen from beneath : *a*, inner branch ; *b*, outer branch.

Fig. 19. Terminal segment of one of the ambulatory limbs.

Fig. 20. Appendage of right side of third abdominal segment of female. A pair of similar appendages exists on the third and fourth abdominal segments.

Fig. 21. Appendage of second abdominal segment of the male : *a*, rudimentary second branch. In this sex there is only one pair besides the swimmerets of the sixth segment.

PLATE IV. *Pinnixa*.

Fig. 1. First stage of the zoëa of *Pinnixa chaetoptera*, from Noank, Conn.

Fig. 2. Abdomen of the same : *a*, spine ; *b*, terminal piece of the telson.

Fig. 3. Second maxilliped of the same : *a*, inner branch ; *b*, outer branch.

- Fig. 4. First maxilliped of the same : *a*, inner branch ; *b*, outer branch.
 Figs. 5-15. Last stage of the zoëa of a *Pinnixa*, from Newport, R. I.
 Fig. 5. Anterior view.
 Fig. 6. Posterior view.
 Fig. 7. Third maxilliped, cheliped, and ambulatory appendages of the future crab, removed from under the carapace of the zoëa : *a'*, *a''*, *a'''*, inner, middle, and outer branches of the third maxilliped ; *b*, cheliped ; *c*, *d*, *e*, *f*, ambulatory appendages ; *g*, gills.
 Fig. 8. Third maxilliped : *a*, inner branch (endognathite) ; *b*, middle branch (exognathite) ; *c*, outer branch (epignathite) ; *d*, gill.
 Fig. 9. Second maxilla : *a*, scaphognathite.
 Fig. 10. Abdomen : *a*, *b*, *c*, *d*, first, second, third, and fourth pairs of abdominal appendages.
 Fig. 11. Second maxilliped : *a*, inner branch ; *b*, outer branch.
 Fig. 12. First maxilliped : *a*, inner branch ; *b*, outer branch.
 Fig. 13. First maxilla : *a*, inner lobe ; *b*, outer lobe ; *c*, palpus.
 Fig. 14. *a*, first antenna ; *b*, second antenna.
 Fig. 15. Metastoma.

NOTE. Figs. 9 and 11-15 were drawn from the exuvie of a zoëa which had changed into a crab.

PLATE V. *Pinnixa*.

- Fig. 1. First crab-stage of a *Pinnixa*, from Newport, R. I. (developed at one moult from the zoëa represented on Plate IV. Figs. 5-15). Dorsal view.
 Fig. 2. The same ; ventral view.
 Fig. 3. The same ; abdomen viewed from beneath, with its appendages.
 Fig. 4. The same ; first antenna.
 Fig. 5. The same ; first maxilliped.
 Fig. 6. The same ; second maxilliped : *a*, endognathite ; *b*, exognathite.
 Fig. 7. The same ; third maxilliped : *a*, endognathite ; *b*, exognathite ; *c*, epignathite.
 Fig. 8. Left chela of adult male *Pinnixa chaetoptera* from Buzzard's Bay. The carapace of this specimen measures 4 mm. in length by 7.5 mm. in breadth.
 Fig. 9. Right chela of a small adult female of the same. Carapace, 3 mm. × 5.5 mm.

THE STALK-EYED CRUSTACEANS OF THE ATLANTIC COAST OF NORTH
AMERICA NORTH OF CAPE COD. BY S. I. SMITH.

THIS paper is the result of work done in preparing a more complete account of the crustaceans of the coast of northern New England for the report of the United States Commissioner of Fisheries. The study of the extensive collections of crustaceans, made during the past fourteen years by Professor Verrill and myself, and particularly during the last seven years under the auspices of the Commission for the investigation of the fisheries, promised to add so much to the knowledge of the relations of the fauna of the western side of the North Atlantic, that it has seemed desirable to publish as early as possible the results bearing upon the geographical distribution of the species. This has been long delayed, however, by the great quantity of material which has each year been added to the collections, so that the time at my disposal has been little more than sufficient properly to separate and care for the specimens themselves. In the present paper I have attempted to give these results for the species of stalk-eyed Malacostraca inhabiting the coast between Cape Cod and northern Labrador. Only a very small portion of the species composing the crustacean fauna is thus included, but it is that portion which is best known and consequently most useful in determining the relations of the fauna. Although the paper has special reference to the geographical distribution of the species, considerable matter is introduced in regard to specific variation and specific characters, and, under some of the species, to the synonymy, where it seemed necessary to the proper understanding of the geographical distribution or to show the propriety of the nomenclature adopted, or where the species is not well-known.

The practice among zoologists of neglecting to make clearly apparent what parts of their writings are based on their own observations and what on the works of others, is a frequent source of annoyance and error. This is particularly the case in the statement of the habitats of species, as often given, without the slightest indication whether the occurrence of the species, in each of the regions specified, is known to the author from personal observation or the examination of specimens collected by others, or whether the statement is based

on the writings of other observers, or whether the author has merely conjectured that the species—perhaps never seen by him—inhabits certain regions. Heretofore my own practice has not always been free from fault in this respect, but throughout the following pages I have been careful to indicate distinctly what portions of the statements are based on my own observations and what are merely copied. To do this in the paragraphs devoted to the geographical distribution of the species, I have used the mark of affirmation (!) after each region from or in which I have examined specimens; but to avoid the too frequent repetition of this mark, in cases where the enumeration of several stations or depths immediately follows the name of a special region or locality, it has been placed after the latter only, it being understood that I have examined specimens from all the stations or depths mentioned under that region or locality. The name of the collector, or of the authority for the locality of the specimens examined,—unless I have myself been collector or observer,—is either inserted in parenthesis after the locality or indicated by the date, as explained below. The authorities for all localities from which I have not examined specimens are similarly indicated in parentheses. In the synonymy, all the references given have been made by direct examination of the works quoted, unless specially indicated to the contrary by the use of quotation marks.

To avoid the repetition of the names of collectors, after the numerous localities on our coast, mentioned under the geographical distribution of the species, the year in which the collections were made is, in most cases, alone inserted; and a short statement of the principal sources whence the collections have been received, is inserted here, that portion which is subsequently referred to as authority for collections being arranged chronologically.

1864. Collections made at Eastport, Maine, on the Bay of Fundy, during September and October, by Professor Verrill and the writer.

1868. At the same locality, during August and the early part of September, also at the Island of Grand Menan and in the deep waters off Eastport; by Prof. Verrill, Prof. H. E. Webster, Rev. Geo. A. Jackson, and the writer.

1870. At the same localities and during the same season as in 1868; by Professor Verrill and Mr. Oscar Harger. Also, by myself upon the southern side of Long Island, during August and the early part of September.

1871. Professors Verrill and J. E. Todd, and the writer made collections, for a short time in April, in the neighborhood of Great Egg

Harbor, New Jersey; a special object of the excursion being the determination of the species described from that region by Say.

The systematic exploration of the waters of our coast were this year begun, in connection with the investigations concerning the coast fisheries, under the direction of Professor Baird, United States Commissioner of Fish and Fisheries. Under these auspices, the larger part of the collections referred to in this paper have been made. In 1871, this work was carried on in the region of Vineyard Sound and Buzzard's Bay, from late in June to the middle of September. The dredging operations and the care of the collections of invertebrates were in my charge during the first part of the season, later in care of Prof. J. E. Todd, and finally under the direction of Professor Verrill, more or less assisted by Professors A. Hyatt and A. S. Packard, Jr., and particularly by Prof. W. G. Farlow, who was specially engaged in collecting and studying the algæ.

1872. Under the auspices of the Commissioner of Fisheries, large collections were made, during July and August, at Eastport, Maine, and in the whole neighboring region of the Bay of Fundy. As in the succeeding years, Professor Verrill had charge of the dredging operations and the collections of invertebrates. For a large part of the season Dr. T. M. Prudden cared for the crustaceans and made valuable notes on the stations and color of the species. For a part of the season Prof. H. E. Webster was at the island of Grand Menan where he made valuable additions to the collection of crustaceans, particularly among the species of *Hippolyte*. Several other gentlemen aided in the general work of collecting, and, for a time in August, Mr. Harger and I were present and took part in the work.

During the last of August and September, a series of dredgings were made, on board the Coast Survey steamer Bache, in the region of St. George's Banks and the adjacent waters. An account of these dredgings has already appeared in the third volume of these Transactions. This, the earliest exploration with the dredge, of the region referred to, was carried out through the coöperation of Professor Baird and the Superintendent of the Coast Survey. During the first cruise, on which dredgings were made on, and east of, St. George's Banks; at Halifax, Nova Scotia; and on Le Have Bank, the dredging was in charge of Mr. Harger and the writer. On the second cruise, dredgings were made by Prof. A. S. Packard, Jr., and Mr. Caleb Cooke, in the region of St. George's Banks. In the latter region the dredgings extend from north latitude $41^{\circ} 25'$ to $42^{\circ} 11'$, and from west longitude $68^{\circ} 10'$ to $65^{\circ} 42'3''$; on Le Have Bank, in

a line about southeast from Cape Sable, Nova Scotia, and a little south of latitude 43° north. The dredgings made by Professor Packard and Mr. Cooke were at five different stations, all on, or near, the northern slope of St. George's Banks, and in 110, 85, 45, 40, and 150 fathoms.

While waiting at Provincetown, Massachusetts, for the *Bache*, Mr. Harger and I were able to observe a large number of the shore and shallow-water species, showing the fauna to be intermediate in many respects between the fauna north and that south of Cape Cod.

1873. Collections were made in, and off, Casco Bay, coast of Maine, during July, August, and the early part of September, under the same auspices and direction as in 1872. During the season I had charge of the crustaceans and was greatly aided by Mr. J. H. Emerton, who not only made many most excellent drawings for use in the final reports upon the crustaceans, but also assisted in the work of collecting.

Through the same coöperation as in 1872, the steamer *Bache* made several trips, during September, to the deeper waters of an extensive region in the Gulf of Maine, between Cape Cod and the coast of the State of Maine. On these trips, Professor Packard and Mr. Cooke took charge of the dredgings, which were made in the following distinct regions: off the coast of Maine, south and east of Penobscot Bay, in 52 to 82 fathoms; a region on and near Jeffrey's Bank, extending from north latitude $43^{\circ} 15'$ to $43^{\circ} 36'$, and from west longitude $69^{\circ} 6'$ to $68^{\circ} 25'$, and at depths from 60 to 107 fathoms; in 52 to 118 fathoms on Cashe's Ledge and to the west of it (the Ledge being in about latitude $42^{\circ} 50'$, longitude $68^{\circ} 50'$, and the dredgings extending to $69^{\circ} 35'$); on and near Jeffrey's Ledge, off the coast of New Hampshire, in 24 to 33 and 95 to 118 fathoms; in the central part of Massachusetts Bay, in 50 and 65 fathoms; in 24 to 33 fathoms on Stellwagen's Bank, the outer barrier of Massachusetts Bay, situated between Cape Cod and Cape Ann; off Massachusetts Bay, 20 to 25 miles northeast of Cape Cod, in 117 and 142 fathoms; and in shallow water just south of Cape Ann.

In April of this year, Professors Verrill and D. C. Eaton made an excursion to Watch Hill, Rhode Island, and made a small collection of special interest on account of the season of the year.

1874. The dredgings, in connection with the work of the Fish Commission, were carried on in the region about the eastern end of Long Island Sound and extended from the mouth of the Connecticut River, to Gardner's and Peconic Bays, to the waters south of Montauk Point, and to the banks south and east of Block Island.

As in 1873, the steamer *Bache* continued the dredgings in the Gulf of Maine. Professor Packard, assisted by Mr. Cooke and Mr. Robert Rathbun, had charge of the work and made large collections between Cape Ann and the Isles of Shoals, on Jeffrey's Ledge, on Cashe's Ledge, and at numerous localities in the deep waters of the Gulf of Maine.

1875. The work under the direction of the Commissioner of Fisheries was in the same region as in 1871, but the dredgings extended further to the eastward and included the region east of Nantucket.

In addition to this, Professor Verrill and Mr. C. Hart Merriam, during a short excursion to Barnstable, on the north side of Cape Cod, made collections of many of the species inhabiting the shores and shallow waters of the southern part of Cape Cod Bay.

1876. Mr. C. Hart Merriam and Mr. E. B. Wilson made some collections at Eastport, Maine, in April, and very kindly submitted the crustaceans to me. The collection was particularly interesting on account of the season at which it was made, all the other collections which I have examined from the same region having been made late in the summer or early in the autumn.

1877. The extensive collecting prosecuted under the direction of the Commissioner of Fisheries was resumed, the collections of the invertebrates being, as before, in charge of Professor Verrill, who was this year assisted by Mr. E. B. Wilson. Extensive collections were made at Salem, Massachusetts, and in the neighboring waters of Massachusetts Bay and the Gulf of Maine. During a part of the season the work was transferred to Halifax, Nova Scotia, where large collections were made and whence the dredging was extended to the deep waters one hundred and twenty miles south of that city. On the passage from Salem to Halifax, dredgings were made in the deep waters of the Gulf of Maine and off the southern portion of the Nova Scotia coast.

1878. The work in connection with the investigation of the fisheries was continued in the vicinity of Cape Ann, the field investigated being contiguous to, and partially overlapping, that in the vicinity of Salem in 1877. In addition to the material obtained upon the shores and by dredging, valuable collections were procured, at Gloucester, Massachusetts, the head-quarters of the Commission for the season, from vessels engaged in the bank-fisheries. Professor Verrill was specially assisted by Mr. Richard Rathbun and Mr. Sanderson Smith. The collections of this year came too late to be used to any considerable extent in the present paper, and consequently only occasional references are made to them.

I was not able to assist in the work of collecting either in 1877 or 1878, but the crustaceans in the collections of these years have nearly all been placed in my hands in the original packages in which the specimens collected at each special locality were placed, so that I am alone responsible for the determination of the species from each of these special localities.

Several gentlemen, in addition to those above mentioned in connection with the work of the Fish Commission, aided in collecting during different seasons; the gentlemen who were specially engaged in investigating the fishes, also, gave every season, more or less assistance in collecting the invertebrates. Mr. G. Brown Goode, who has for several years had charge of the work upon the fishes, should be particularly mentioned in this connection.

Mention should also be made of the small collections which have, from time to time, been made, in the interest of the United States Fish Commission, by Mr. Vinal N. Edwards in the vicinity of Wood's Holl, Massachusetts (Vineyard Sound and Buzzard's Bay). These collections have been made mostly in the winter and spring and for this reason have proved of special interest, often containing species rarely or never taken in summer, and in several cases materially helping to complete the annual history of a species.

For the use of a few specimens of rare species, not fully represented in the collections above referred to, and also for the freest access to the collections under their charge, I am under obligation to the officers of the Boston Society of Natural History, the Peabody Academy of Science at Salem, and the Portland Society of Natural History. In addition to the use of the collections made under the auspices of the United States Fish Commission, I am indebted to Professor Baird for the opportunities of examining several collections from our southern coast and from Europe, for the loan of books, and for the use of several of the drawings made by Mr. Emerton, which appear in the accompanying plates. To Professor Verrill, I am indebted for the constant use of the valuable collection of crustaceans, of which I formerly had charge, in the Museum of Yale College, as well as for his advice and assistance in many ways. The Museum, in addition to the collections above referred to, contains large collections made in the vicinity of New Haven during many years; an authentic set from the collection which served as a basis for Professor Packard's work upon the invertebrate fauna of Labrador, contained in the first volume of the *Memoirs of the Boston Society of Natural History*; a very valuable series of the crustacea of the coast of Norway, received from

Professor G. O. Sars; a similar series from the British Isles, received from the Reverend A. M. Norman; and a miscellaneous collection of authentically determined species received through Professor A. Milne-Edwards, from the Jardin des Plantes at Paris. These European collections have been of the greatest service for comparison with our closely allied or identical species. The collection from the Reverend Mr. Norman, however, has been received since the following pages were written, so that it is only occasionally referred to.

To the kindness of Mr. J. F. Whiteaves of Montreal, I am indebted for the opportunities of examining very nearly all the crustaceans obtained in his extended explorations of the Gulf of St. Lawrence. Brief accounts of these explorations by Mr. Whiteaves, whose investigations have added very largely to the knowledge of the fauna of the Gulf of St. Lawrence, are contained in his several reports to the Minister of Marine and Fisheries for the Dominion of Canada.

Gelasimus pugnax Smith.

Salt-marshes at Provincetown! (1872) and Barnstable! (1875), Massachusetts, and south to Florida! (Col. W. E. Foster, Dr. H. S. Williams, et al.) and the island of Hayti! (Dr. D. F. Weinland, J. S. Adam).

Gelasimus pugilator Latreille ex Bosc.

Muddy and sandy flats, Provincetown!, Massachusetts, 1872, to the west coast of Florida! (Col. E. Jewett). These species of *Gelasimus* and the two following species belong properly to the fauna of southern New England, which, as I have elsewhere remarked, seems to extend across Cape Cod into the shallow waters of Cape Cod Bay.

Callinectes hastatus Ordway ex Say.

A large specimen of this species has been reported from Salem, Massachusetts, (C. Cooke, American Naturalist, i, p. 52, 1867). This individual was probably only a wanderer from farther south, although the species may occur in Cape Cod Bay, during favorable seasons.

Platyonichus ocellatus Latreille ex Herbst.

Provincetown! (1872) and Barnstable! (1875), Massachusetts; abundant at the latter place. Fort Macon!, North Carolina (Coues, Packard), to Key West, Florida (Gibbes). Sandy shores and bottoms, low water to 10 fathoms.

Carcinus mænas Leach ex Linné.

Provincetown!, Massachusetts, 1872, to New Jersey!, 1871. The European coast!, from Finmark (M. Sars) and the Baltic (Möbius) to both sides of the Mediterranean (Grube, Lucas, Heller) and the Black Sea (Rathke). It has also been reported from Brazil by Heller (Reise der Novara, Crust., p. 30, 1865) and from the Hawaiian Islands by Streets (American Naturalist, xi, p. 241; and Bulletin United States National Museum, No. 7, p. 109, 1877). In the Museum of Yale College there is a single specimen, unquestionably of this species, which was sent from Panama Bay, with a large collection of other marine animals, in 1866, by Professor F. H. Bradley. At these last three localities it seems to be very rare, and possibly accidental.

The range of this species upon the eastern coast of North America, as far as I can ascertain from positive information, is very limited. Streets states that "it is by no means an uncommon crab along the whole extent of the eastern coast of the United States," but gives no special localities, and I am inclined to believe that he generalized, very naturally, without carefully examining the facts. From personal observation, I know the species is common and often very abundant in Vineyard Sound, Buzzard's Bay, various parts of Long Island Sound, and in the bays on the south side of Long Island. I also observed it at Provincetown, Massachusetts, in 1872, and at Great Egg Harbor, New Jersey, in 1871. From beyond these limits, either north or south, I have never seen specimens nor any positive record of their occurrence. It is not a regular inhabitant of Casco Bay or the Bay of Fundy. I have examined several large collections from Fort Macon, North Carolina, and others from the coast of South Carolina, both coasts of Florida, Key West, and the east coast of Mexico, without finding a single individual of the species. It is not mentioned in Stimpson's list of Beaufort, North Carolina, species (Amer. Jour. Sci., II, xxix, p. 444, 1860), nor that of Coues for the same locality (Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 120), nor is it mentioned from special localities in the Southern States by Gibbes, nor by any one else as far as I am aware. I know of no other common species of crustacean with a similarly restricted habitat upon our coast.

It is most abundant between tides or near low-water mark and is seldom found below a very few fathoms in depth.

Geryon quinquedens, sp. nov.Plate IX, figures 1, 1*a*, 1*b*, 2.

This species is closely allied to *G. tridens* Kröyer (Plate IX, figures 3, 3*a*) but is at once distinguished from it by the armament of the antero-lateral margins of the carapax.

In the larger specimens, the carapax, including the lateral spines, is about a third broader than long. The dorsal surface is considerably convex longitudinally, but only slightly transversely, entirely naked, finely, but irregularly, granulated, and not deeply areolated. The most prominent elevation is a short, rounded, transverse ridge each side, between the base of the lateral spine and the posterior portion of the gastric region. The front is narrower and more prominent than in *G. tridens*, its breadth between the tips of the inner angles of the orbits only equaling the width of the orbit itself between the tips of its inner and outer angles. The median teeth of the front are near together, triangular, and deflexed below the level of the inner angles of the orbits, in front of which they project for almost or quite their whole length. The outer angles of the orbits are acutely angular, but broader and less spiniform than in *G. tridens*. The next tooth (the second of the five normal teeth of the antero-lateral margin), which is entirely wanting in *G. tridens*, is a well-developed angular projection of the margin, but less prominent than the first tooth and not acutely angular. The third tooth is prominent, acutely triangular, but scarcely spiniform, and much shorter than in *G. tridens*. The fourth tooth, which, like the second, is entirely wanting in *G. tridens*, is represented by a distinct but only slightly angular emargination which is more conspicuous in the smaller than in the larger specimens. The postero-lateral margins are nearly straight as in *G. tridens*. In young specimens the three larger teeth of the antero-lateral margin are more acute and spiniform than in the larger specimens examined.

The eyes, antennulæ, antennæ, and epistome are very nearly as in *G. tridens*, but the inner angle of the inferior margin of the orbit is much less prominent in the new species. In *G. tridens*, this angle projects as a slender tooth to the extremity of the peduncle of the antenna, reaches as far as the outer angle of the orbit and nearly as far as the front itself (Plate IX, figure 3*a*), while in our species it is much less slender, falls far short of either of the other angles of the orbit and reaches but slightly beyond the third segment of the antenna (figure 1*a*).

The chelipeds, in the largest male examined (figure 1*b*), as well as in the females and young, are only slightly unequal and rather slender. The fingers on each hand are about as long as the basal portion of the propodus and their thin prehensile edges are armed with sharp serrations which shut slightly by on the two fingers when the dactylus is closed. The dactylus of the larger cheliped, in all the specimens, has, in addition to the serrations, a small obtuse tubercle near the base. In the only specimen of *G. tridens* examined (a male considerably larger than the largest specimens of *G. quinquedens*), the chelipeds are more unequal, the larger being proportionally stouter, and the teeth of the prehensile edges of the fingers are more obtuse and the proximal ones even obtusely tuberculiform; this may be, however, only a character of very old individuals. The sternum, ambulatory legs, and abdomen afford no distinctive characters.

The following are measurements of seven of the nine specimens before me, and also of a specimen of *G. tridens*, from Christiania Fiord, Norway, received from Professor G. O. Sars.

Carapax.	<i>a</i> , ♂	<i>b</i> , ♂	<i>f</i> , ♂	<i>c</i> , ♀	<i>f</i> , ♀	<i>d</i> , ♀	<i>e</i> , ♀	<i>G. tridens</i>
Length including frontal teeth,	33 _{mm}	45	28.7	28.5	25.6	21.7	12.2	56
Breadth including lateral spines,	45	58	36.8	38	33.7	29.1	16.7	75
Ratio of length to breadth,	1:1.36	1:1.29	1:1.28	1:1.33	1:1.32	1:1.34	1:1.37	1:1.34
Breadth in front of lateral spines,	39	51.8	32.5	32.3	29.2	24.4	13.8	64
Ratio of length to this breadth,	1:1.18	1:1.15	1:1.13	1:1.13	1:1.14	1:1.13	1:1.13	1:1.14
Length of posterior legs,		95	57	52	50	39	24	115

This very interesting species was first known to me, about ten years ago, from two specimens, in the collection of the Portland Society of Natural History, obtained by Mr. C. B. Fuller from stomachs of fishes taken in deep water off Casco Bay. These specimens were somewhat shrunk from partial digestion, immersion in alcohol and subsequent drying, and the measurements (given above in column *a*) of the smaller one of the two may be slightly incorrect. The other specimens which I have examined were all taken in deep water in the Gulf of Maine, off Massachusetts Bay. The largest two of these (*b* and *c*) were obtained, August 19, 1877, by Professor Verrill and party of the United States Fish Commission on board the "Speedwell," at 160 fathoms, soft muddy bottom, about forty miles east of Cape Ann, latitude 42° 38' north, longitude 69° 38' east. Two others were dredged off Massachusetts Bay by Professor Packard, while on board the "Bache" in September, 1873: a female (*d*), carrying an abundance of eggs, in latitude 42° 18' north, longitude 69° 49' east, 142 fathoms, soft blue mud; and a very small female (*e*), latitude 42° 20' north, longitude 70° east, 117 fathoms, on a bot-

tom of the same character. Four other specimens (*f*), two males and two females, one of which was carrying eggs, were dredged near these localities, August 31, 1878, latitude $42^{\circ} 33'$, longitude $69^{\circ} 35'$, in 100 to 115 fathoms, mud and stones. Fragments of a large specimen were also found in the stomach of a cod-fish taken in ninety-eight fathoms, soft mud, fourteen miles southeast of Cape Ann, September 2, 1878.

The *G. tridens* was described by Krøyer (Naturhistorisk Tidsskrift, i, p. 10, pl. 1, 1836) from specimens taken on the coast of Denmark. It has since been reported from Christiania Fiord, in ten to twenty fathoms (G. O. Sars, Christiania Videnskabs-Selskabs Forhandling for 1873, p. 393) and a few other Scandinavian localities, and from off Valentia, Ireland, in 159 fathoms (Thomson, "Depths of the Sea," p. 87, fig. 9, 1873). Like its American representative, it seems to be a deep-water species rarely taken in the dredge.

Panopeus depressus Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett, et al.). This and the next species are apparently regular inhabitants of Cape Cod Bay. They are both, but more particularly this species, very abundant upon oyster-beds everywhere south of Cape Cod and are often carried alive long distances among oysters, so that it is difficult to determine their exact northern range.

Panopeus Sayi Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett). Apparently less abundant, at least on the New England coast, than the last.

Panopeus Harrisii Stimpson ex Gould.

Massachusetts Bay! (Coll. Boston Soc. Nat. Hist.) and Long Island Sound! to St. John's River, Florida! (G. Brown Goode). This species, originally described by Gould, from Charles River, Massachusetts, is apparently a thoroughly brackish-water form. The specimens from the St. John's River, as I am informed by Mr. Goode, were taken at Arlington Bluffs, twenty-two miles from the mouth. It was associated at this place with *Sesarma cineria*, *Palæmonetes vulgaris*, and a *Bopyrus* which infested the branchial cavity of nearly every specimen of the latter species. Mr. Goode writes that these species were taken in water perfectly fresh to the taste, though brackish water is sometimes driven by the wind up the river to where they occurred.

Cancer irroratus Say.

Cancer irroratus (♂ only, ♀ being of the next species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 59, pl. 4, fig. 2, 1817.—Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 50 (4), 1859.—A. Milne-Edwards, Nouvelles Archives du Muséum d'Hist. nat. Paris, i, p. 191, 1865.—Verrill, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 312 (18), 1874.—Smith, in Verrill, op. cit., pp. 530 (236), 546 (252), 1874.

Platycarcinus irroratus Milne-Edwards, Hist. nat. des Crust., i, p. 414, 1834.—DeKay, Nat. Hist. of New York, Crust., p. 6 (in part), pl. 2, fig. 2, 1844.

Cancer Sayi Gould, Report on Invertebrata of Massachusetts, 1st edit., p. 323, 1841.

Platycarcinus Sayi DeKay, op. cit., p. 7, 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 176 (12), 1850.

Cancer borealis Packard, Memoirs Boston Soc. Nat. Hist., i, p. 303, 1867.

South Carolina (Gibbes), apparently rare. Fort Macon, North Carolina! (Coues, Yarrow). Great Egg Harbor!, New Jersey, 1871; apparently not very common in the muddy bays, but thrown up in large numbers upon the sandy outer beaches. Southern shore of Long Island!, 1870; on sandy beaches. Long Island Sound!; abundant on sandy and rocky shores. Equally abundant, in similar situations, along all the rest of the south coast of New England, and in Cape Cod! (1872, 1875), Massachusetts! (1877, 1878), and Casco! (1873) Bays. Apparently much less abundant in the Bay of Fundy! (1864, 1868, 1870, 1872), and at Halifax!, Nova Scotia (1872, 1877). Gulf of St. Lawrence!, 1873; "the common crab of the Gulf" (Whiteaves). "Not uncommon at Caribou Island, Straits of Belle Isle," south coast of Labrador! (A. S. Packard, Jr.).

The exact bathymetrical range of the adult is not easily determined, since full-grown specimens are seldom taken in the dredge. Specimens of considerable size were frequently taken in the trawl in Vineyard Sound, in from 6 to 12 fathoms, but I have never seen adult specimens from below the latter depth, although young individuals are often taken at much greater depths. Small specimens, from 10 to 25^{mm} in breadth of carapax, were common in shallow-water dredgings in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and were taken off Newport!, Rhode Island, in 29 fathoms, mud, 1871; in the region of St. George's Banks!, 30 to 50 fathoms, sand, sand and shells, and coarse sand, 1872; on Stellwagen's Bank!, 34 to 44 fathoms, sand, 1873,—one specimen about 40^{mm} in breadth of carapax; off Cape Ann!, Massachusetts, 26 fathoms, rocks, 1878; not rare on sandy and hard bottoms in Casco Bay!, in 5 to 10 fathoms, and once taken, between Eagle and Bates Islands, in 24 fathoms, hard bottom, 1873; several localities in and near Halifax Harbor!,

Nova Scotia, 16 to 21 fathoms, on bottoms of fine sand, and of fine sand and red algæ, 1877.

Found in abundance in the stomachs of the cod (!) taken in Casco Bay and the Bay of Fundy.

When found living between tides it is usually concealed among rocks or buried beneath the sand. It is usually much more abundant at or just below low-water mark than between tides, however.

The largest specimens I have examined are from Casco Bay. One of these, a male, has the carapax 83^{mm} long and 129.2^{mm} broad.

Cancer borealis Stimpson.

Cancer irroratus (♀ only, ♂ belonging to the last species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 57, 1817.—Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 322, 1841.—Stimpson, Marine Invertebrata of Grand Manan, p. 59, 1853 (*teste* Stimpson).

Platycarcinus irroratus DeKay (in part), Nat. Hist. of New York, Crust., p. 6 (but not the figure), 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 177 (13), 1850.

Cancer borealis Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 54 (4), 1859.—Verrill, Invertebrate Animals of Vineyard Sound, pp. 486 (192), 493 (199) 1874.—Smith, in Verrill, op. cit., pp. 546 (252), 745 (451), 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, p. 317 (2), 1878.

Plate VIII.

Near Noank!, Connecticut (eastern end of Long Island Sound), 1874. Off Watch Hill!, Rhode Island, April, 1873; a small specimen dredged in four to five fathoms, among rocks and algæ. Nomansland!, 1871. Vineyard Sound!, 1871, 1875. Salem!, Massachusetts (J. H. Emerton). Casco Bay!, 1873. Bay of Fundy and Nova Scotia (Stimpson).

Leidy (Journal Acad. Nat. Sci. Philadelphia, iii, p. 149 (17), 1855) mentions "*Platycarcinus irroratus* M. Edw." and "*P. Sayi* DeKay" from Point Judith, Rhode Island, and Great Egg Harbor, New Jersey, intending, doubtless, to indicate both our species of *Cancer*, although the names with the authorities as given are in reality synonymous and apply to *C. irroratus* only.

Kingsley (loc. cit.) reports a young specimen of this species from Fort Macon, North Carolina. He also says: "I am informed by Mr. Faxon that there are specimens in the Museum of Comparative Zoology, at Cambridge, from the Bermudas," and that "it ranges from Nova Scotia to the West Indies," but fails to give any explanation of this last extension of its range southward.

In habits this species differs very greatly from *irroratus*. The best opportunities which I have had for observing it were at Peak's Island, in Casco Bay, August and September, 1873. Empty carapaces, chelipeds, etc., of *borealis* were at first found in abundance scattered along the outer shores, far above the action of the waves, where they had evidently been carried by gulls and crows, and were also found in considerable numbers half a mile from the shore in a forest of coniferous trees thickly inhabited by crows. For several weeks no living specimens of *borealis* were discovered, although the *irroratus* was found living in abundance all about the island, without, however, its remains scarcely ever being found scattered about with those of *borealis*. The *borealis* was finally discovered in abundance, at low water, on the exposed and very rocky shores of the northern end of the island. At this locality, between eighty and ninety specimens, all females and many of them carrying eggs, were obtained in a single morning. They were all found in situations exposed to the action of the waves and were either resting entirely exposed upon the bare rocks and ledges, or clinging to the sea-weeds in the edge of the waves or in the tide-pools. They were never found concealed beneath the rocks, where, however, *irroratus* abounded. It is a much heavier and more massive species than the *irroratus* and is consequently much better adapted than that species to the situations in which it is found. So many individuals falling a prey to birds is evidently a result of the habit of remaining exposed between tides, although the heavy shell must afford much greater protection than the comparatively fragile covering of *irroratus* would afford to that species if similarly exposed. The *borealis* was also found at a somewhat similar locality, but more exposed to the sea, on Ram Island Ledge, a low reef open to the full force of the ocean. One specimen of moderate size was dredged in the ship channel between Peak's Island and Cape Elizabeth, in ten fathoms, rocky and shelly bottom, and specimens were several times captured in "lobster-traps" set, at a depth of eight or ten fathoms, among rocks. Specimens were also several times found in stomachs of the cod taken on the Cod Ledges.

In the vicinity of Vineyard Sound, this species was not infrequently found thrown upon sandy beaches, but never upon beaches very far removed from rocky reefs. The following are the localities where it was seen in greatest numbers: along the sandy beach of Martha's Vineyard from Menemsha Bight to Gay Head; the rocky island of Cuttyhunk; and the rocky outer shores of Nomansland, where dead specimens were found in considerable abundance.

In the vicinity of Noank, Connecticut, it was occasionally found dead upon the shores and was several times obtained from "lobster-traps."

The largest specimens I have seen are two males, of almost exactly the same size, one from Casco Bay, the other from near Noank, Connecticut. The carapax of the specimen from Casco Bay is 91.6^{mm} long and 144.5^{mm} broad.

Chionœcetes opilio Krøyer.

Cancer phalangium O. Fabricius, Fauna Groenlandica, p. 234, 1780 (not of J. O. Fabricius, 1775).

"*Cancer opilio* O. Fabricius, Det Kongelige Danske Vidensk. Selskabs Skr., nye Samling., iii, p. 180" (*teste* Krøyer).

Chionœcetes opilio Krøyer, Grönlands Amfipoder. Det Kongel. Danske Vidensk. Selskabs naturvidensk. og mathem. Afhandlinger, vii, p. 313 (85), 1838; *Conspectus Crustaceorum Groenlandiæ*, Naturhistorisk Tidsskrift, ii, p. 249, 1838; in Gaimard, Voyages en Scandinavie, en Laponie, au Spitzberg et aux Féroë, Crust., pl. 1, 1849.—Packard, Memoirs Boston Soc. Nat. Hist., i, p. 302, 1867.—Whiteaves, Report on a second deep-sea dredging expedition to the Gulf of St. Lawrence [in 1872], p. 15, 1873.

Peloplastus Pallasii Gerstæcker, Carcinologische Beiträge, Archiv für Naturgeschichte, xxii, 1856, p. 105, pl. 1, fig. 1.

Chionœcetes Behringianus Stimpson, Proceedings Boston Soc. Nat. Hist., vi, p. 84, 1857; Journal Boston Soc. Nat. Hist., vi, p. 448 (8), 1857; Proceedings Acad. Nat. Sci. Philadelphia, 1857, p. 217 (23), 1858.

Chionocoetes phalangium Lütken, list of the Crustacea of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 146.

From fish-stomachs, off Casco Bay! (C. B. Fuller, Portland Soc. Nat. Hist.), *h*. Two localities off the coast of Nova Scotia!, 1877: two specimens (*e*, *f*) off Cape Sable, 88 fathoms, very fine sand; and four small specimens about twenty-six miles south of Chebucto Head, 101 fathoms, fine sand. A large male specimen (*d*) in the collection of the Boston Society of Natural History is without indication of locality, but probably came from one of the fishing banks. Gulf of St. Lawrence (Whiteaves). Straits of Belle Isle and Chateau Bay!, coast of Labrador (A. S. Packard, Jr.), *a*, *b*. Greenland (O. Fabricius, Krøyer, Norman). Siberia (Gerstæcker). Arctic Ocean! (Capt. Rodgers, North Pacific Expl. Expd.), *i*. Bering Straits! (North Pacific Expl. Expd.), *c*, *g*.

A careful comparison of three of the original specimens of *C. Behringianus* with specimens from our North Atlantic coast, and with Krøyer's figure and description, convinces me that Stimpson's species is perfectly identical with the *C. opilio* of Greenland. The differ-

ences in the proportional lengths of the first and second pairs of legs, referred to by Stimpson, are variations due wholly to age and sex. The proportions given by Kröyer apply well to large males, like the specimen represented in his figure above referred to, while those given by Stimpson apply to specimens of smaller size. The following measurements exhibit these variations and show that they are even much greater in very young specimens than indicated by Stimpson. The proportions of the carapax in the specimen from Casco Bay (*h*)^a may have changed slightly by contraction in drying after partial digestion in a fish-stomach.

	<i>a.</i>	<i>b, ♂.</i>	<i>c, ♂.</i>	<i>d, ♂.</i>	
Length of carapax,	11.7mm.	17.0	27.3	115	
Breadth of carapax,	9.5	15.0	25.2	120	
Ratio of length to breadth,	1:0.81	1:0.88	1:0.92	1:1.04	
Between external angles of orbits,	7.3	9.6	14.0	49	
Length of cheliped,	11.5	28.5	32	220	
Length of anterior ambulatory leg,	19.5	31.0	55	300	
	<i>e, ♀.</i>	<i>f, ♀.</i>	<i>g, ♀.</i>	<i>h, ♀.</i>	<i>i, ♀.</i>
Length of carapax,	22.2	33.0	35.0	59	64.0
Breadth of carapax,	21.1	33.0	34.3	65	68.5
Ratio of length to breadth,	1:0.95	1:1	1:0.98	1:1.10	1:1.07
Between external angles of orbits,	12.3	17.2	18	27	
Length of cheliped,	23.0	37.7	36	67	
Length of anterior ambulatory leg,	44.3	72	61	120	125

Upon the New England coast this species is very rare and apparently confined to deep water and to the off-shore banks. It is one of the largest arctic crabs and occasionally attains gigantic proportions. The extent of the ambulatory legs, in the largest individual referred to above, was about 800 millimeters (over two and a half feet), while the specimen figured by Kröyer was even somewhat larger.

I have not been able to consult Otho Fabricius' original description of *Cancer opilio*, referred to by Kröyer, nor even to ascertain with certainty the exact date of its publication, which was very likely subsequent to that of *Cancer opilio* of J. C. Fabricius (*Entomologia systematica*, ii, p. 458, 1793), which is *Inachus opilio* of the same author (*Supplementum entom. system.*, p. 356, 1798) and the *Pisa armata* of Milne-Edwards. Even if priority of publication belongs to the species of J. C. Fabricius, I should not regard such a preoccupation in the ancient genus *Cancer* as sufficient reason for rejecting a name so well-established as *opilio* for the species under discussion. I see far less reason for restoring the old name *phalangium* which had not been in use for this species for more than three quarters of a

century, which was certainly preoccupied by J. C. Fabricius' *Cancer phalangium* (*Stenorhynchus phalangium* Milne-Edwards), and which was apparently rejected by Otho Fabricius himself.

Hyas araneus Leach ex Linné.

Massachusetts Bay, about ten miles southeast from Salem!, 35 fathoms, mud and clay nodules, 1877; Stellwagen's Bank!, 22 to 34 fathoms, sand and rocks, common, 1873. Casco Bay!, 1873, at the following localities: Haddock Ground off Whaleboat Island, 14 fathoms, gravel and broken shells; Broad Sound, 16 to 22 fathoms, stones and shells; northwest of Eagle Island, 13 fathoms, spongy bottom. Bay of Fundy!, 1868, 1872. Le Have Bank!, latitude 42° 44' north, longitude 64° 36' west, 60 fathoms, sand and gravel, 1872. Off Chebucto Head!, Nova Scotia, 20 fathoms, mud and fine sand, 1872. In and near Halifax Harbor!, N. S., 1877: 16 to 21 fathoms, very fine sand and red algæ; 18 fathoms, mud and fine sand, Sept. 15, very large specimens, some carrying eggs; 16 to 25 fathoms, rocks and nullipora, and stones, gravel, etc.; also in Bedford Basin, 35 fathoms, soft mud, a small specimen only. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence!, "rare" (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (O. Fabricius, Krøyer et al.); Disco Island, 5 to 20 fathoms (Valorous Cruise, Norman). Sea of Ochotsk (Brandt, Middendorff's Sibirische Reise, Krebse, p. 79, 1851). Iceland (G. O. Sars). Spitzbergen (Goës, Æfversight af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 161 (1)). Coast of Norway! (G. O. Sars), British Islands! (Norman), and on the continent of Europe, as far south as the coast of Belgium (Van Beneden), and according to Milne-Edwards (Hist. nat. des Crust., i, p. 312, 1834) to that of France.

Upon our coast this species is much less abundant than the next. I have never seen specimens from south of Cape Cod.

Hyas coarctatus Leach.

Coast of New Jersey (Leidy) and of Long Island (Say). Block Island Sound!, 8 to 15 fathoms, stones, gravel and sand; and Cox's Ledge!, east-southeast of Block Island, 21 fathoms, rocky bottom, 1874. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy,—abundant; Jeffrey's Ledge!, 24 fathoms, gravel and stones,—abundant; and Massachusetts Bay!, 29 and 33 fathoms, gravel and stones, 1873. Massachusetts Bay, off Salem!, 1877: 22 fathoms, gravelly; 48 fathoms, soft mud, August 13,—some females carrying eggs. Gulf of

Maine!, off Cape Ann; seven miles southeast by east one-half east of Cape Ann, 75 fathoms, soft mud, 1878; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft mud, 1877. Platt's Bank! (latitude $43^{\circ} 11'$ north, longitude $69^{\circ} 35'$ west), 32 fathoms, sand; and near Jeffrey's Ledge!, 51 fathoms, mud and gravel, and 125 fathoms, mud, 1874. Casco Bay!, 1873: many localities in and near Portland Harbor, 9 to 24 fathoms, muddy, gravelly, and rocky bottom; East and West Cod Ledges, 10 to 15 fathoms, very rough and rocky,—taken with both the dredge and tangles, and also, in abundance, from stomachs of the "rock-cod;" 33 fathoms, hard, and 35 fathoms, muddy bottom, off Seguin Island; 64 and 68 fathoms, mud, sixteen to twenty miles southeast of Cape Elizabeth,—large specimens. Off the coast of Maine, near Monhegan Island!, 42 to 65 fathoms, muddy and gravelly bottom, 1874. Cashe's Ledge!, 27 to 40 fathoms, rocks and gravel, 1873, and 52 to 90 fathoms, rocky, 1874,—abundant. St. George's Banks!, 1872; 45 fathoms, coarse sand; 50 fathoms, sand and shells; 60 fathoms, gravel, stones and sponges. North of George's Banks!, latitude $42^{\circ} 11'$ north, longitude $67^{\circ} 11'$ west, 150 fathoms, soft sandy mud, 1872. Bay of Fundy!, 1864, 1868, 1870, 1872, rarely taken among rocks at low-water mark!, and not uncommon in 10 to 77 fathoms.

West of Brown's Bank!, about latitude $42^{\circ} 44'$ north, longitude $66^{\circ} 27'$ west, 75 fathoms, sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, sand, gravel and stones, 1872. Off Cape Negro and off Shelburne, Nova Scotia!, 47 fathoms, stony, and 59 fathoms, pebbles, sand and rocks, 1877. In and near Halifax Harbor, Nova Scotia!, 1877, 18 to 57 fathoms, common on bottoms of rocks, rocks and nullipora, gravel and sand, fine sand and mud, and sand and red algæ. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence! (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (Reinhardt et al.); Disco Island (Norman). Norway! (G. O. Sars), British Islands! (Norman), and the continent as far south as the British Channel (Milne-Edwards). Stimpson has reported this species as collected by the North Pacific Exploring Expedition, in Bering Straits and Bering Sea (Journal Boston Soc. Nat. Hist., vi, 450 (10)), and Brandt (op. cit., p. 79) records a variety, which he names "*alutacea*" (*us*), from the Sea of Ochotsk. Stimpson, however, subsequently (Proceedings Acad. Nat. Sci. Philadelphia, 1857, p. 227 (24)) in his official report makes no mention of specimens of

H. coarctatus but describes a new species, *latifrons*, as common in Bering Sea, apparently using the same specimens which were a few months before referred to *H. coarctatus*. *H. latifrons*, though closely allied to *coarctatus*, is certainly a good species, or a very remarkable variety, and quite distinct from Brandt's variety *alutaceus*. The occurrence of the true *coarctatus* in the arctic region west of America is therefore left doubtful.

This species apparently furnishes an important part of the food of the cod.

Libinia emarginata Leach.

Libinia emarginata Leach, Zoological Miscellany, ii, p. 130, pl. 108, 1815.

Libinia canaliculata Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 77, pl. 4, fig. 1, 1817.

Not uncommon in the shallow parts of Casco Bay! where protected from the cold outside waters, 1873. More common in Massachusetts! and Cape Cod! (1875) Bays. Abundant in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and south to Key West!, Florida, (Gibbes), Nassau!, New Providence (Dr. Edward Palmer), and the west coast of Florida! (Col. E. Jewett).

It is a strictly shallow-water species, probably never occurring below ten fathoms, and appears to delight in muddy bays and inlets where the water is slightly brackish, though it often lives in pure sea-water and in exposed situations.

Leach's name *emarginata* takes precedence of Say's *canaliculata*. Leach states that "the locality of this species, which is the only one of the genus which has yet been observed, is unknown." A careful examination of his figure (which represents a female with the carapax about 65 millimeters long) convinces me of the certainty of the identity of his species with that of Say. White (List of Crust. in British Museum, p. 4) doubtfully retains the two species, although he places two males from Boston, U. S., under *emarginata* with Leach's type. The variation due to sex and age are very marked, and both Milne-Edwards and White probably failed to unite the species from want of a good series of specimens. Although Say mentions Leach's figure he evidently compared it with males of his species, from which alone his description was apparently taken.

Lithodes maia Leach ex Linné.

Off Cape Ann!, Massachusetts, 1875 (received from fishermen). Casco Bay! (Museum Yale College, received from A. S. Packard, Jr.) Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky, 1873. In

1878, fine specimens were obtained from off Sable Island!, Nova Scotia, 250 fathoms, rocks (Philip Merchant and Thomas Ginnevan, schooner "Marion"); from Marble Head Bank (schooner "Charger"); and one caught, in 1872, in Harbor Cove, Gloucester (Edw. W. Hodgkins). Specimens are occasionally brought from different fishing banks off the coast, where they are taken on trawl or cod lines, especially upon rocky bottoms. It has been reported from Greenland, but it is not inserted in Reinhardt's list (Rink's *Naturhistoriske Bedrag til en Beskrivelse af Grönland*, 1857, p. 28) and Lütken in a foot-note to his list (Manual of Instructions for the [British] Arctic Expedition, 1875, p. 146) says its occurrence in Greenland needs confirmation.

In Europe it is found upon the whole Atlantic coast of Scandinavia! (G. O. Sars), about the northern portions of the British Islands, and, according to Van Beneden, rarely upon the coast of Belgium.

***Eupagurus bernhardus* Brandt ex Linné.**

Not rare in the eastern part of Long Island Sound!, Block Island Sound!, and off Block Island!, in 10 to 50 fathoms, sandy and hard bottoms, 1874; all the specimens small, however. Off Newport!, Rhode Island, 29 fathoms, 1872. Not uncommon in the deeper parts of the outer portion of Vineyard Sound!, 1871 and 1875; large specimens were taken in 8 to 12 fathoms, sandy bottom, near Menemsha Bight, and also at about the same depth, rocky bottom, off Gay Head. South of Cape Cod, it appears not to be abundant and I have never seen it at low-water.

Stellwagen's Bank!, 34 fathoms, sand, 1873. Gloucester!, Massachusetts, abundant at and just below low-water, 1878. Off Cape Ann!, 33 fathoms, gravel and stones, 1873. Very common in Casco Bay!, 1873, in 3 to 30 fathoms, sandy, gravelly, rocky, shelly and spongy bottoms, and occasionally on soft muddy bottoms in shallow water; dredged also in 48 to 64 fathoms, mud, sixteen to twenty miles off Cape Elizabeth, and found at low-water mark!, among rocks, on Ram Island Ledge. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was occasionally found at low-water, and was common at the same depths and on similar bottoms as in Casco Bay; also dredged off White Head!, Grand Menan, in 40 to 50 fathoms, 1872. In the region of St. George's Banks!, 1872, it was dredged in abundance in 25 to 45 fathoms, sand; and in less abundance in 50 fathoms, sand and shells, and 150 fathoms, sandy mud. In and near Halifax Harbor, Nova Scotia!, 18 to 25 fathoms, sand, gravel, stones, and sand and

red algæ, 1877. I have never seen specimens from the Gulf of St. Lawrence nor Labrador and can find no record of its occurrence on our eastern coast north of Halifax. I have little doubt however that it occurs in the southern part of the Gulf of St. Lawrence.

On the European coast it is found from Finmark (M. Sars) and the rest of the Norwegian coast! (G. O. Sars) to the Baltic, the North Sea! (Möbius, Metzger), the British Islands! (Norman), and south to the coast of France (Milne-Edwards).

It is also reported from the region of Bering Sea by Owen and Brandt, and by Stimpson from Puget Sound.

Eupagurus longicarpus Stimpson ex Say.

Egmont Key!, west coast of Florida, common (Col. E. Jewett). Charleston, South Carolina (Gibbes). Fort Macon!, North Carolina, abundant (Coues, Packard). Also abundant on the coast of New Jersey!, 1871; southern shore of Long Island!, 1870; throughout Long Island Sound!; Block Island Sound!, 1874; Gardiner's!, Great Peconic! and Little Peconic! Bays, Long Island, 1874; Buzzard's Bay!, and Vineyard Sound!, 1871, 1875. Cape Cod Bay!, 1875, and Provincetown!, Massachusetts, 1872. Salem, Massachusetts (Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 326). Common at low-water, in a shallow and sheltered cove at the upper end of Quahog Bay!, an arm of Casco Bay, 1873.

It is most abundant at low-water or between tides on muddy and sandy shores and is seldom if ever found below 10 fathoms.

Eupagurus pubescens Brandt ex Kröyer.

Off the coast of New Jersey!, latitude 40° north, longitude 73° west, 32 fathoms, inhabiting shells overgrown with *Epizoanthus Americanus* Verrill (Capt. Gedney). Off Block Island!, 14 fathoms, sand and gravel, 1874. Stellwagen's Bank!, 22 to 44 fathoms, sand, 1873,—abundant. Massachusetts Bay!, off Salem, 1877: 22 and 45 fathoms, gravel; 33, 35 and 36 fathoms, sand and mud; and abundant in 48 to 50 fathoms, mud. Gulf of Maine!, off Cape Ann: seven miles southeast by east one-half east from Cape Ann, 75 fathoms, soft mud, 1878,—abundant; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft mud, 1877,—abundant and very large. Off Massachusetts Bay!, latitude $42^{\circ} 20'$ north, longitude 70° west, 117 fathoms, soft blue mud, 1873. Common in Casco Bay!, 1873, on muddy, sandy, shelly and spongy bottoms in 10 to 48

fathoms; also found at low-water mark!, among rocks, at Ram Island Ledge, and dredged in 48 to 64 fathoms, mud, 16 to 20 miles off Cape Elizabeth. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was found in abundance at about the same depths as in Casco Bay, was rarely found at low-water mark, and, in 1872, was dredged in 77 fathoms, mud and stones, off Head Harbor, near Eastport, and also in 97 to 105 fathoms, gravel and sand, off White Head, Grand Menan. In 1873, it was dredged, eight miles south off Monhegan Island!, off the coast of Maine, in 64 fathoms, mud and sand; and in 1874, on Cashe's Ledge!, in 27 fathoms, rocks and gravel. In the region of St. George's Banks!, 1872: 30 and 40 fathoms, sand; 50 and 60 fathoms, sand and shells; 65 fathoms, dead shells; and 150 fathoms, sandy mud. About thirty miles southeast one-half east from Cape Sable!, Nova Scotia, 88 fathoms, very fine sand, 1877. In Bedford Basin!, Halifax, 35 fathoms, soft mud, 1877. In and near Halifax Harbor!, 1877, 15 to 42 fathoms, sand, sand and red algæ, rocks, mud and stones. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Kröyer, Norman). Bering Sea (Brandt, Stimpson). In the European seas, upon the coasts of Scandinavia and the British Islands.

On account of the apparent confusion of this species with the next I am not able to give the range of either of them upon the European coast with any certainty.

Eupagurus Kröyeri Stimpson.

This species and the last, although very closely allied and having apparently very similar geographical distribution, appear to be entitled to rank as distinct species; at least I have not been able to discover, in examining several hundreds of specimens, any which are intermediate between the two forms indicated by Stimpson. The *Kröyeri* attains nearly or quite as great size as the *pubescens*, but Stimpson had only small specimens of *Kröyeri* and the differences which he mentions in the relative lengths of the chelipeds and ambulatory legs do not hold good for full-grown specimens. The other differences which he points out, however, are quite sufficient for separating the species. The difference in the amount of pubescence is usually fully sufficient to distinguish them at a glance, but the form and ornamentation of the chelipeds afford the best distinctions. The tubercles and spines,—except the single series along the edge of the dorsal carina of the propodus of the left, or smaller, cheliped,—are

much smaller and more crowded on both chelipeds in *Kröyeri* than in *pubescens*. In *Kröyeri* the outer or left hand edge of the propodus of the smaller cheliped, as seen from above, is distinctly incurved near the base of the digital portion, while in *pubescens* the corresponding edge is full and regularly, though not strongly, arcuate, so that the digital portion of the propodus is much wider toward the base than in *Kröyeri*. In *Kröyeri* the dorsal carina of the propodus of the smaller cheliped is much nearer the right side toward the base than in *pubescens*, is very high and sharply prominent, and surmounted by a single series of dentiform teeth; the narrow space beneath the carina to the right is nearly or quite destitute of spines or tubercles; and the outer surface, or that to the left of the carina, is flat or slightly concave, and covered with very small tubercles. In *pubescens* the carina is low, obtuse and armed with a crest of spines which becomes a double series proximally; and the outer surface is slightly convex and is armed with scattered spiniform tubercles.

Kröyer's figure in Gaimard's *Voyages en Scandinavie*, Crustacés, plate ii, figure 1, evidently represents the *Kröyeri*, although the tubercles upon the chelipeds are represented in the figures as a little too large and more scattered than in any specimens I have seen, but this is probably due to a slight and very natural inaccuracy on the part of the artist or engraver; the original description of *Pagurus pubescens* (*Naturhistorisk Tidsskrift*, ii, p. 251, 1839), however, applies best to the other species, which Kröyer evidently had before him when writing the first phrase of the diagnosis, "cephalothoracis superficie dorsali pedibusque pilis flavis dense obsitis," which would not apply to any specimens of *Kröyeri* or to his figure published ten years after. Kröyer mentions having numerous specimens from different places on the Greenland coast and from Iceland, and it is probable, as Stimpson suggests, that he failed to distinguish the two species, as nearly all carcinologists have done since.

While having a geographical range similar to the *pubescens*, the *Kröyeri* is apparently a more strictly arctic species, and, upon the New England coast, is most common in deep water and upon the off shore banks.

Stellwagen's Bank!, 29 to 44 fathoms, rocky and sandy, 1873, common. Massachusetts Bay!, off Salem, 43 and 50 fathoms, mud, 1877. Casco Bay!, 8 to 30 fathoms, rocky, spongy and sandy bottoms, and occasionally on muddy bottoms also, 1873. Bay of Fundy!, 1864, 1868, 1870, 1872, in similar situations as in Casco Bay, and more common and of larger size; in 1872, it was also dredged off Head.

Harbor in 77 fathoms, mud and stones; and off White Head, Grand Menan, in 40 to 50 fathoms, and 97 to 105 fathoms. In the region of St. George's Banks!, 1872, it was common in 50, 60 and 65 fathoms, sand and shells; 45 fathoms, coarse sand; 150 fathoms, sand and mud; and six rather small specimens were brought up from 430 fathoms, sand, gravel and stones. Near Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky; 65 fathoms, mud and sand, and 110 fathoms, mud, 1873-4. Fifteen miles southeast of Monhegan Island!, off the coast of Maine, 82 fathoms, brown mud, 1873. Off Shelburne!, Nova Scotia, 47 fathoms, stony, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, stones and sponges, abundant, 1872. Halifax Harbor!, Nova Scotia, 16 fathoms, fine sand and red algæ, 1877. Off Halifax!, 57 fathoms, mud and pebbles, 1877. One hundred and twenty miles south of Halifax!, 190 fathoms, 1877. Gulf of St. Lawrence!, "widely distributed through the Gulf" (Whiteaves). Labrador (A. S. Packard, Jr.). Greenland (Krøyer). Puget Sound (Stimpson). Lofoten Islands!, coast of Norway (G. O. Sars), and probably all the coast of northern Europe. Those from the coast of Norway, labeled *pubescens* by Professor G. O. Sars, are very characteristic specimens of *Krøyeri*. Norman's remark under *Pagurus pubescens* (Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci. for 1867, p. 264) that "a variety occurs in which the hands are entirely free from the hairs which ordinarily clothe them" probably refers to this species.

Parapagurus, gen. nov.

The genus here proposed is allied to *Eupagurus* and *Paguristes*, but the branchiæ (of which there are eleven pairs, two each at the bases of the external maxillipeds and the three first pairs of cephalothoracic legs, and three at the bases of the fourth pair of cephalothoracic legs,—as in *Eupagurus bernhardus*) are composed of numerous cylindrical papillæ, as in the majority of *Macrura*, instead of lamellæ, as in most *Paguroids*. It also differs from *Eupagurus* in having well-developed and symmetrically paired male appendages upon the first and second segments of the abdomen, and from *Paguristes* in the chelipids being very unequal and the external maxillipeds widely separated at their bases,—in both of which characters it agrees with *Eupagurus*. The small size of the eyes, the great length of the antennulæ and antennæ, and the narrowness of the sternum between the bases of the second and third pairs of cephalothoracic legs, are apparently additional generic characters.

Parapagurus pilosimanus, sp. nov.

Male. The carapax is divided by the deep cervical suture, which is arcuate,—not in the form of a truncated V with irregular sides, as in *Eupagurus*. The anterior portion is slightly broader than long, smooth, and almost entirely naked. The anterior margin is more nearly straight than in the species of *Eupagurus*, but projects in a well-marked, though broad and obtuse, rostrum, each side of which the margin is straight to the lateral margin, except a very slight prominence between the bases of the eye-peduncles and antennæ. The posterior portion of the carapax is but little broader than the anterior portion and is only slightly expanded posteriorly.

The eye-peduncles are slender, taper distally, are scarcely as long as half the width of the front of the carapax, and are clothed with long hairs along the upper side. The cornea is very small, almost wholly terminal, and the pigment black. The ophthalmic scales are small, spiniform, slender, and acute.

The peduncles of the antennulæ are very long and slender; the proximal segment is about as long as the eye-peduncle; the second and third are nearly cylindrical, though the second is slightly compressed laterally, smooth, and almost perfectly naked; the second is about as long as the first, and the third fully twice as long. The dorsal, or major, flagellum is more than three-fourths as long as the distal segment of the peduncle, is composed of about forty segments, tapers to a very long and slender tip, and is densely clothed beneath with hairs. The inferior, or minor, flagellum is very slender, about half as long as the superior, and composed of eight or nine segments. The peduncles of the antennæ reach to the distal end of the second segment in the antennular peduncle, and the segments have pretty nearly the same form and proportions as in *Eupagurus bernhardus*. The acicles reach to the tips of the peduncles and are densely hairy above, while the rest of the peduncle is smooth and nearly naked. There is no tooth or spine at the inner side of the base of the acicle, but outside the base there is a prominent dentiform lobe denticulated at its extremity. The flagella of the antennæ extend far beyond the long ambulatory legs, are very slender, smooth, and almost entirely naked.

As seen from without, the inner oral appendages do not differ essentially from the corresponding parts in *Eupagurus*. The three or four distal segments of the endognaths of the external maxillipeds are, however, more cylindrical and a little more slender than in *Eupagurus bernhardus*.

The right cheliped is stout and about as long as the whole body of the animal. The propodus is minutely tubercular and somewhat pubescent on the outer and under sides, which together form a continuous and strongly convex surface; the inner inferior angle is armed with small tubercles, but the distal margin, along the articulation with the carpus, is smooth and unarmed. The carpus is almost as long as the basal portion of the propodus, subcylindrical, without lateral angles, and its whole surface minutely tubercular and clothed with dense, but very fine and soft, light-colored pubescence. The basal portion of the propodus is pretty nearly as broad as long, flattened vertically, evenly convex above and below, with the lateral margins rounded, and the whole surface, except a small space near the base beneath, as well as the basal portion of both fingers, tuberculated and clothed like the surface of the carpus. The digital portion of the propodus is rather slender and tapers rapidly to the calcareous tip, so that its prehensile edge has an oblique direction toward the right. The dactylus corresponds in form with the digital portion of the propodus and is about as long as the inner margin of that segment. The prehensile edges of both fingers are nearly straight and armed with a few, low and obtuse tubercles. The left cheliped is very slender, about three-fourths as long as the right, and the carpus and propodus are less tubercular than in the right, but are clothed with a similar dense pubescence. The propodus is but little longer than the carpus, is scarcely as broad and considerably thinner. The digital portion, as well as the dactylus, is nearly as long as the basal, slender, and slightly curved downward at the tip. The tips of both fingers are horny, their prehensile edges sharp, but the rest of the surface rounded and naked, except for the scattering fascicles of short setæ arising from little pits in the surface.

Both pairs of ambulatory legs reach far beyond the tip of the right cheliped and, except the dactyli, are smooth and almost entirely naked. The second pair are a little longer and slightly stouter than the first but do not differ in other respects. In both pairs the carpal segments are about half as long as the meral and reach to the distal extremity of the carpus of the right cheliped; the propodal segments are slightly longer than the meral. The dactyli are considerably longer than the propodi, slender, strongly curved, particularly toward the very slender and acute tips; they are compressed laterally, the sides being nearly smooth and naked and having a very shallow, longitudinal groove extending to the strongly curved terminal portions which are still more compressed and very

slightly twisted; the inferior edge, and the superior, except on the terminal portion, are rounded, and the superior has a few scattered setæ which become more numerous and regular near the tip, where the edge is compressed and sharp for a short distance. All the distal portion of each of the short fourth and fifth pairs of cephalothoracic legs have the same form and structure as in *Eupagurus bernhardus*, but are a little less hairy.

The sternal plates between the bases of the ambulatory legs are very narrow, the bases of the first pair being nearly contiguous, and those of the second separated by a triangular plate longer than broad and with its posterior margin excavated. The sternal portion of the penultimate segment of the cephalothorax is much broader than that in front of it, but the calcareous plate, as in *Eupagurus*, is a slender transverse rod, which is here much above the plain of the sternal plates in front, so that the coxæ of the penultimate pair of legs project abruptly much below it. The sternal portion of the posterior segment does not differ essentially from the same part in *Eupagurus bernhardus*. The inferior edges of the coxæ of the posterior pair of legs, however, are compressed below and the sexual orifices are in the posterior side instead of in the ventral edge.

The sternal portion of the first segment of the abdomen is closely united with the corresponding part of the last cephalothoracic segment, and the first pair of male appendages arise near together and almost between the coxæ of the posterior cephalothoracic legs. This first pair of male appendages, in the single specimen here described, are about $7\frac{1}{2}^{\text{mm}}$ long and each is composed of a single plate, slightly thickened toward the base, but the distal half expanded into a thin lamella which is rolled into a slightly tapering half tube with its concavity facing inward and posteriorly. The second pair of appendages arise from the sides of the abdomen a considerable distance behind the first pair and are consequently widely separated at their bases. Each one is about $11\frac{1}{2}^{\text{mm}}$ long and composed of a cylindrical basal segment to which is articulated a somewhat longer lamellar terminal segment; this terminal segment (which is so arranged that, when applied to the grooved surface of the corresponding appendage of the first segment, they together form a tube) has, on its anterior side, a shallow groove which terminates on the outer side of the appendage at a point a little way from the tip, and beyond this point the extremity of the appendage narrows into a slender, pointed and hairy tip.

The appendages of the left side of the third, fourth and fifth abdominal segments, as in the males of *Eupagurus*, are each com-

posed of a short basal portion, a linear outer lamella about three times as long as the base, and a very slender and minute inner lamella. The appendages of the sixth segment show nothing to distinguish them from the corresponding appendages in the species of *Eupagurus*. The telson is about as long as broad and its posterior margin is arcuate and only very slightly emarginate in the middle.

Measurements.

Length from front of carapax to tip of abdomen,	-	-	-	60·mm
“ of carapax along median line above,	-	-	-	21·7
“ “ from front to cervical suture,	-	-	-	13·4
Breadth of carapax at bases of antennæ,	-	-	-	12·0
Length of eye-peduncles,	-	-	-	6·3
“ peduncle of antennula,	-	-	-	22·0
“ ultimate segment of same,	-	-	-	11·2
“ major flagellum “	-	-	-	9·0
“ minor “ “	-	-	-	5·0
“ peduncle of antenna beyond front,	-	-	-	11·0
“ flagellum of antenna,	-	-	-	110·
“ chelipeds,	-	-	right, 61·	left, 45·
“ carpus in chelipeds,	-	-	18·	12·
“ propodus in chelipeds,	-	-	26·	15·
Breadth of “ “	-	-	13·7	6·5
Length of dactylus, “	-	-	14·0	8·7
“ first ambulatory leg, left side,	-	-	-	83·
“ propodus of same,	-	-	-	20·
“ dactylus “	-	-	-	27·8
“ second ambulatory leg, left side,	-	-	-	90·
“ propodus of same,	-	-	-	24·
“ dactylus “	-	-	-	32·5

Of this remarkable species I have seen only a single specimen, received, after the first part of this paper was in type, from Mr. Daniel McEachern, schooner “Guy Cunningham,” Gloucester, Massachusetts. It was taken, probably upon a trawl line, in 250 fathoms, hard bottom, off the coast of Nova Scotia, nearly due south of Halifax, north latitude 42° 41', west longitude 63° 6', and was inhabiting a peculiar compound actinoid polyp, which had evidently first grown upon the spiral gasteropod shell inhabited by the crab, afterward extended far beyond the shell, which it has very nearly or quite absorbed, and continued its growth rudely in the form of the original shell; very much as *Epizoanthus Americanus* forms spiral cases inhabited by *Eupaguri*.

Munadopsis curvirostra Whiteaves.

American Journal of Science, III, vol. vii, p. 212 (3), 1874; Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence!, 180 to 220 fathoms (J. F. Whiteaves).

Homarus Americanus Milne-Edwards.

New Jersey! (1871) to the Gulf of St. Lawrence! (Whiteaves) and reported as rare at Henley Harbor (just north of the Straits of Belle Isle), coast of Labrador, by A. S. Packard, Jr.

Axiu serrat Stimpson.

Plate X, figures 4, 4a.

The original specimen described by Dr. Stimpson (Proceedings Boston Soc. Nat. Hist., iv, p. 222, 1852) is preserved, in a dried state, in the collection of the Peabody Academy of Science, Salem. Stimpson states that it was taken, by Mr. S. Tufts, of Lynn, in 20 fathoms, off Situate, a town upon the southern shore Massachusetts Bay. The only specimen I have seen is a partially digested one found in the stomach of a flounder (*Glyptocephalus cynoglossus*), taken about five miles southeast from Cape Ann, 42 fathoms, mud, August 15, 1878. The species will very likely prove to be identical with the European *S. stirynchus*.

The specimen figured is the one originally described by Stimpson.

Calocaris Macandréæ Bell.

History of British Crustacea, part v, p. 233, fig., 1847.—Goes, Crustacea decapoda podoplthalma marina Sueciæ, Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, 1863, p. 167 (7).—G. O. Sars, Hardangerfjordens Fauna, part i, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 259 (16); Om en hidtil lidet kjendt mærkelig Slægtstype af Polyzoer, Christiania Videnskabs-Selskabs Forhandling, 1873, pl. 9, fig. 1.—Whiteaves, American Journal of Science, III, vol. vii, p. 212 (3), 1874.—Report on further Deep-Sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence, 190 fathoms, mud, twenty miles southwest of the southwest point of the island of Anticosti (Whiteaves). On the European coast it has been found in deep water about the British Islands and on the coasts of Scandinavia. I have seen no specimens.

Crangon vulgaris J. C. Fabricius ex Linné.

Fort Macon!, North Carolina (Coues, Packard). New Jersey! 1871. South shore of Long Island!, 1870. Abundant along the whole New England coast, from low-water mark to 30 fathoms or more, but somewhat less numerous north of Massachusetts Bay. Stellwagen's Bank!, 34 fathoms, sand, 1873. Massachusetts Bay!, off Salem, 20 fathoms, rocks and gravel, and 48 fathoms, soft mud, 1877. In the region of George's Bank!, 28, 30 and 45 fathoms, sand, 1872. Halifax!, Nova Scotia, abundant and very large at or near low water, and dredged in 16 and 18 fathoms, on bottoms of sand,

sand and mud, fine sand and red algæ, stones and red algæ, and rocks. Gulf of St. Lawrence!, "common everywhere in shallow water and at low-water mark on most sandy beaches" (Whiteaves). Caribou Island, Straits of Belle Isle (Packard). From the northern part of the Norwegian coast (Sars) to the Baltic (Möbius), North Sea (Metzger), British Islands! (Norman), and south to the north shores of the Mediterranean (Heller, et al.).

This species is found in greatest abundance in shallow water and on sandy or weedy bottoms, but occurs also on muddy, shelly and rocky bottoms, and extends at least to about 50 fathoms in depth.* It varies very much in coloration according to the location in which it is found. Upon the exposed and light-colored sandy shores of southern New England, specimens are invariably translucent and very pale in color so as to closely resemble the surface upon and beneath which they live, while upon dark-colored muddy bottoms they are very much darker in color. Specimens from a dark-colored muddy inlet of Vineyard Sound and others from dark muddy and sandy bottom at Halifax, Nova Scotia, are very dark indeed, the pigment spots covering nearly the entire surface, and the caudal appendages becoming almost black toward the tips.

Crangon boreas J. C. Fabricius ex Phipps.

Massachusetts Bay!, off Salem, 22 fathoms, gravelly bottom, 1877. Stellwagen's Bank!, fifteen to seventeen miles south-southeast from Cape Ann, 23 to 33 fathoms, gravel, stones and sponges, 1878,—common and of large size, one female being 63^{mm} in length. Casco Bay!, from stomachs of codfish taken on West Cod Ledge, and a single specimen dredged near the Ledge in 10 to 20 fathoms, rocky bottom, 1873. Bay of Fundy!, occasionally taken among rocks at low water!; common in 5 to 25 fathoms, rocky, gravelly, and shelly bottoms; and abundant at special localities in Johnson's and South

* According to my own observations, this species is very rare at depths greater than 45 fathoms and I have no positive evidence of its occurrence below 48 fathoms. There is, however, in the collections made off Cape Ann, in 1878, a single, small specimen, unquestionably of this species, which is labeled as having been dredged in 140 fathoms, soft mud, about forty miles east by south from Cape Ann. The specimen was alone in a vial when received and there may have been some mistake in the labeling, or it may have been taken among floating sea-weeds. My statement (Invertebrate animals of Vineyard Sound, Report of the U. S. Commissioner of Fish and Fisheries, part i, p. 550 (256)) that this species "extends from low water to 60 or 70 fathoms," was probably carelessly made from memory. Kingsley (Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 89 (1)), states that it is "common in 70 fathoms," without, however, giving any special locality or authority.

Bays, in 10 to 15 fathoms, on rocky bottoms overgrown with sponges, ascidians, hydroids, algæ, etc.; 1864, 1868, 1870, 1872, 1876. Halifax!, Nova Scotia, 1877: 18 fathoms, fine sand; 20 fathoms, shingly; and 25 fathoms, gravelly. Orphan Bank!, and off Cape Bon Ami, Gulf of St. Lawrence (Whiteaves). Square Island!, coast of Labrador, 15 to 30 fathoms (A. S. Packard, Jr.) Coasts of Grinnell Land and Greenland as far north as latitude $81^{\circ} 44'$ (Miers). East coast of Greenland (Buchholz). Iceland (Krøyer). Along the whole coast of North America to Bering Straits (Stimpson) and the Siberian coast (Brandt). Spitzbergen (Goës). Finmark (M. Sars). Lofoten Islands!, coast of Norway (G. O. Sars).

Robert Bell, Jr. (Canadian Naturalist and Geologist, iv, p. 210, 1859) records "a specimen corresponding nearly with Bell's description" of *Crangon sculptus*, from off Cape Chatte, Gulf of St. Lawrence, but was probably mistaken in the identification of the species, having had most likely *Crangon boreas*, or perhaps one of the species of *Sabinea*.

Sabinea septemcarinata J. C. Ross.

Crangon septemcarinatus Sabine, Supplement to the Appendix of Parry's first Voyage, p. ccxxxvi, pl. 2, figs. 11-13, 1824.—Milne-Edwards, Hist. nat. des Crust., ii, p. 343, 1837.—(?) Brandt, Middendorff's Sibirische Reise, Krebse, p. 114 (Davis' Straits).

Sabinea septemcarinata J. C. Ross, in J. Ross, Appendix to the narrative of a second Voyage in search of a northwest passage, p. lxxxii, 1835.—(?) M. Sars, Christiania Videnskabs-Selskabs Forhandling for 1858, p. 125, 1859 (coast of Norway).—(?) Stimpson, Proceedings Academy Nat. Sci. Philadelphia, 1860, p. 25 (94) (Arctic Ocean near Siberia).—(?) Packard, Memoirs Boston Soc. Nat. Hist., i, p. 302, 1867 (Thomas Bay, coast of Labrador).

Sabinea (*Crangon*) *septemcarinata* Krøyer, Naturhistorisk Tidsskrift, iv, p. 244, pl. 4, figs. 34-40, and pl. 5, figs. 41-44, 1842. (Not *Crangon septemcarinatus* Krøyer, Grönlands Amphipoder, p. 314 (86), 1838; and Naturhistorisk Tidsskrift, ii, p. 252, 1838).

Plate XI, figures 5, 9, 10, 11, 12, 13.

Two distinct species have been confounded under the name *septemcarinata*. In one of these the rostrum as seen from above is short and obtusely rounded at the tip, and the extremity of the telson is subtruncate and armed with a series of eight or more spines or stout setæ; in the other species the rostrum is acutely pointed and the telson terminates in an acute tip, with one or two spines each side. Sabine's original description and figures show very plainly that he had the first of these species, and to this species also Krøyer's figures and descriptions, above referred to, apply. I have, however, received, from Professor G. O. Sars of Christiania, both species under the name

septemcarinata, from the coast of Norway, and I have myself recorded, under the same name, specimens of the second species, taken by Mr. Harger and myself upon Le Have and St. George's Banks in 1872.

Of the *septemcarinata* there are over one hundred specimens before me, and all of them agree very closely in the form of the rostrum and telson, and in the armament and sculpturing of the carapax and abdomen. The rostrum is nearly horizontal, scarcely overreaches the eyes when they are directed forward, is obtusely rounded at the extremity as seen from above, and has a median dorsal carina which is most prominent near the tip. The dorsal carina of the carapax is well marked, but the teeth with which it is armed are not very prominent and in none of the specimens are there more than five in all. Of these spines the anterior is minute and scarcely forms a part of the carina, the second, third and fourth are about equal in size, while the fifth is smaller and very near the posterior margin, or wholly wanting in some of the smaller specimens. The subdorsal carinæ are distinct and irregularly dentate posteriorly, but on the anterior third of the carapax are faintly indicated and not at all, or only very obscurely, dentate. The superior lateral carinæ terminate anteriorly in a short tooth at the outer angle of the orbit but are not distinctly dentate near the anterior border of the carapax. The inferior lateral carinæ are strongly dentate anteriorly but posteriorly the teeth become very small or even obsolete.

The telson falls considerably short of, or reaches nearly to the tips of, the inner lamellæ of the uropods. Its extremity is truncated,—or rather terminates in a very obtuse and rounded angle,—and is usually armed with ten to fourteen slender spines or spiniform setæ. This armament of the tip of the telson is subject to considerable variation, apparently for the most part due to wear or to accidental injuries of various kinds; but there seems to be no approach to the structure in the next species. The number of spines varies slightly in different specimens but consists regularly of an even number—there being no median spine,—those cases where there is an odd number being apparently the result of accident. In small specimens which are very little worn, the spines are slender and vary much in length, the outer ones being short while those toward the center are very long, often fully equal in length to the breadth of the extremity of the telson, and ciliated toward their tips. This perfect form of armament is well shown in the specimen of a male figured (Plate XI, figure 10) and, in the specimens examined, seems to be more common among the males, although some of the young females have it in nearly as great per-

fection. In large specimens and those which are slightly worn the spines are usually much shorter, stouter and more uniform in length, and show scarcely any trace of ciliation (Plate XI, figure 11). In specimens considerably worn the spines are, of course, frequently partially or wholly destroyed.

The males are much smaller than the females; the largest male, among the specimens examined, is 45^{mm} in length and the largest female, 72^{mm}, which represents very nearly the average difference in size. In the armament of the carapax and of the extremity of the telson the sexes agree perfectly. The males are at once distinguished from the females, however, by the longer flagella of the antennulæ and antennæ.

Massachusetts Bay!, 1877, common in 35, 48, and 50 fathoms, muddy bottom, August 6 to 10,—many of the females carrying eggs; and taken also in 20 fathoms, rocks and gravel, and 36 fathoms, mud and fine sand. Off Cape Ann!, 1878, in 26 to 60 fathoms, common on muddy bottoms, and occasionally on sandy, pebbly and rocky bottoms. Gulf of Maine!, off the Isles of Shoals, 25 fathoms, rocky, 1874, and eight miles south of Monhegan Island, 64 fathoms, mud and sand, 1873,—only a single very small specimen in each case. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, August 12, 1873,—two females, one carrying eggs. Off Halifax!, Nova Scotia, 1877, 52 fathoms, fine sand and mud, September 21,—common; 57 fathoms, mud, gravel and stones, September 5,—two females, one carrying eggs. Gulf of St. Lawrence!, 60 fathoms, 1872 (J. F. Whiteaves). West coast of Davis' Straits (Sabine). Greenland (Reinhardt, Lütken). Iceland (Krøyer). Spitzbergen (Krøyer). Lofoten Islands!, coast of Norway (G. O. Sars),—one male with two large females of the next species.

Sabinea Sarsii, sp. nov.

Plate XI, figures 6, 7, 8.

The eyes, antennulæ, and the thoracic appendages differ very slightly if at all from those of the last species; the lateral squamiform appendage of the first segment of the peduncle of the antennula, in all the specimens examined, is, however, more prominent and acute than in *septemcarinata*. The rostrum reaches considerably beyond the eyes and, as seen from above, terminates in an acute tip. The dorsal carina of the rostrum is sharper and higher than in the last species and extends to the very tip, which is obtusely rounded as seen laterally. The dorsal carina of the carapax is sharper and its teeth more prominent, and usually more numerous, than in the last species.

The subdorsal carinæ are distinct and distinctly, and pretty regularly, dentate throughout. The superior lateral carinæ are better marked than in the last species and terminate in an acute and prominent tooth at the outer margin of the orbit, and just back of this there is a distinct tooth in the carina itself. The elaborate sculpturing of the dorsal surface of the abdomen, though apparently after the same pattern as in *septemcarinata*, is much more distinct and conspicuous.

The telson, in all the specimens seen, reaches to or slightly beyond the tips of the inner lamellæ of the uropods. The distal portion is a little more slender than in the last species and the dorsal aculei appear slightly more conspicuous. In adult specimens, the extremity terminates in an acute tip much longer than its breadth at base, where it is separated from the body of the telson by an emargination each side, from each of which arise two spines, a large inner one with a minute one outside at its base; this is the structure in the two perfect adult specimens examined, the larger of the two females from the coast of Norway (Plate XI, figures 6*b*, 6*c*) and a smaller individual of the same sex from the Gulf of Maine, 1877, (Plate XI, figure 7). In a very small specimen, only 16^{mm} in length, from St. George's Banks (Plate XI, figure 8), and in a still smaller specimen from Le Have Bank, the extremity of the telson is acutely triangular and armed each side with three slender spines of nearly equal length,—evidently an approach to the early stages of the young.

St. George's Banks!, 60 fathoms, shells and sand, 1872,—one young specimen 16^{mm} in length. Gulf of Maine!, about east-southeast from Cape Sable, Nova Scotia, latitude 42° 40' north, longitude 66° 58' west, 112 fathoms, gravel, August 20, 1877,—one female 36^{mm} in length. Le Have Bank!, 60 fathoms, coarse gravel, stones and sponges, September 12, 1872,—a female, 47^{mm} in length, carrying eggs, and a small specimen badly mutilated. Lofoten Islands!, coast of Norway (G. O. Sars),—two fine females, 62 and 53^{mm} in length.

I take great pleasure in associating the name of Professor G. O. Sars with this species.

Pontophilus Norvegicus M. Sars.

"*Crangon Norvegicus* M. Sars, Beretning om en zoologisk Reise ved Kysten af Romsdals Amt i Nyt Magazin f. Naturv., 11 B., 1861, p. 8" (Sars).—Goës, *Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar*, Stockholm, 1863, p. 173 (13).

Pontophilus Norvegicus M. Sars, *Christiania Videnskabs-Selskabs Forhandlinger*, 1861, p. 183; *Bidrag til Kundskab om Christianiafjordens Fauna* (extr. Nyt Mag-

azine for Naturvidenskaberne), p. 2, pl. 1, figs. 1-25, pl. 2, figs. 17-37, 1868.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Mag. Nat.), p. 14, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna (extr. Nyt Mag. Nat.), p. 17, 1869; Christiania Videnskabs-Selskabs Forhandling, 1871, p. 261 (18), 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 291, 1875.

Gulf of Maine!, about thirty miles east-southeast from Cape Ann, 115 fathoms, mud, sand, gravel and stones, August 24 and 31, 1878,—four specimens, one female about 70^{mm} long. Off the coast of Nova Scotia!, about thirty miles south of Halifax, 101 fathoms, fine sand, and 110 fathoms, fine sand and mud, September 6 and 20, 1877,—twenty-four specimens. It was previously known only from the Scandinavian coast. Coast of Norway!, 30 to 500 fathoms (G. O. Sars).

Nectocrangon lar Brandt ex Owen.

About twenty miles southeast from Cape Sable!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Common in Bedford Basin!, Halifax, Nova Scotia, 26-41 fathoms, mud, and also about ten miles off Halifax!, 52 fathoms, fine sand and mud, 1877. Gulf of St. Lawrence! (J. F. Whiteaves). St. Johns, Newfoundland (Stimpson). Labrador! (A. S. Packard, Jr.). Greenland (Krøyer, Norman). Bering Sea (Brandt, Stimpson). "Arctic Ocean" (Owen, Stimpson).

Caridion Gordoni Goës.

"*Hippolyte Gordoni* Bate, Nat. Hist. Review, v, p. 51." (Norman.)

Doryphorus Gordoni Norman, Annals and Magazine of Nat. Hist., III, viii, p. 277, pl. 13, figs. 6, 7, 1861 (from Moray Firth); Report British Assoc. Advanc. Sci., 1868, p. 265 (Shetland Isles). The name *Doryphorus* is preoccupied, having been used by Cuvier in 1829 for a genus of reptiles.

Caridion Gordoni Goës, Crustacea decapoda podophthalma marina Sueciæ, Æfversigt af Kongl. Vetenskaps. Akad. Förhandlingar, 1863, p. 170 (10), 1863.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 13, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna, p. 21, 1869; Christiania Videnskabs-Selskabs Forhandling, 1871, p. 261 (18), 1872.—Smith, Transactions Connecticut Acad., iii, p. 28, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 290, 1875.

Off the coast of New Hampshire, between the Isles of Shoals and Jeffrey's Ledge!, 51 fathoms, mud and gravel, 1874. Casco Bay!, from the stomach of cod taken on West Cod Ledge, August 21, 1873,—a female carrying eggs. Gulf of Maine!, on and near Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, 1874, and south of the

Ledge, in 52 to 90 fathoms, rocky, 1873,—common. Near St. George's Banks!, 110 fathoms, "sand and mud with a few stones," 1872,—one young specimen. Bay of Fundy!, 40 to 50 fathoms, rocky, Aug. 14, 1868,—a female carrying eggs; and off White Head, Grand Menan, 40 to 50 fathoms, 1872. On the European coast it has been recorded from Scotland! (Norman), the North Sea (Metzger), and the west coast of Norway!, 150 to 200 fathoms (G. O. Sars).

As the above record of stations shows, this species is an inhabitant of hard, and usually rocky, bottoms in deep water. This is probably the reason of its apparent rarity, since such localities are not common and are difficult of exploration with the dredge.

European specimens, received from the coast of Norway through Prof. G. O. Sars, agree with all the American specimens examined in having well developed epipodi at the bases of the second, third and fourth cephalothoracic legs, as well as in all other respects. The dentition of the rostrum is subject to considerable variation. In twenty-two specimens examined, varying from 17 to 27^{mm} in length, four had the formula, $\frac{6}{1}$; seven, $\frac{7}{1}$; nine, $\frac{8}{1}$; one, $\frac{9}{1}$; and one, $\frac{7}{2}$;—each of the last two cases being adult specimens from Cashe's Ledge.

Hippolyte Leach.

In accordance with the rules for zoological nomenclature as at present generally accepted, the name *Hippolyte* should not be applied to the species now usually included under it and ought to be restored to the species without mandibular palpi, and for which Stimpson has proposed the new generic name *Virbins*.

The genus *Hippolyte*, as first proposed by Leach in 1813 or '14 (Edinburgh Encyclopædia, American edition, vol. vii, p. 271),* contains but one species, *H. varians* Leach, and in 1815 in the Transactions of the Linnean Society, vol. xi, p. 347, *variens* is still retained as the first species and a new species, *inermis*, added. In the first of these publications there is, under *Hippolyte*, the observation that "to this genus the *Cancer Astacus gibbosus* of Montagu belongs," and in both of them the "*Cancer spinus* of Sowerby" is referred to *Alpheus*. In 1817, in the Malacostraca Podophthalmata Britannicæ, however, Leach says, "Montagu sent to me *Hippolyte varians*, the type of this genus, as his *Cancer astacus gibbosus*, but he afterwards informed

*I have not been able to examine the original edition. The American edition seems, however, at least as far as the article under consideration is concerned, to be an exact reprint of the original, with changes only in paging and division into volumes.

me, by letter, that his figure and description had been made from mutilated specimens, of what he had since ascertained to be a very distinct species, and requested me to take the earliest opportunity to correct his mistake," thus fully disposing of Montagu's species and unquestionably establishing *varians* as the type of the genus. In this last work the genus *Hippolyte* includes five species, as follows: *H. Prideauxiana* (apparently the same as the *inermis* mentioned above), *H. Moorii* (a variety of the last), *H. varians* (*Virbius varians* of Stimpson), *H. Chranchii*, and *H. Sowerbæi* (Leach's *Alpheus spinus*, here for the first time referred to *Hippolyte*).

Numerous other more or less allied species were added to the genus by subsequent authors, but little was added to our knowledge of the structure and real affinities of the species until the appearance of Kröyer's monograph, in 1842, in which many new arctic species were very fully described and figured and the structural differences between them made known. Kröyer's first section of the genus contained but one species, the *smaragdina*, apparently synonymous with Leach's *varians*. This section of the genus is equivalent to Stimpson's genus *Virbius* (Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 35 (104), 1861), which is characterized specially by non-palpigerous mandibles, the absence of epipodal appendages upon the external maxillipeds and thoracic legs, and by the tri-articulate carpus of the second thoracic legs, and, as originally constituted, included *Hippolyte acuminata* Dana, *H. viridis* Milne-Edwards, *H. smaragdina*, *H. obliquimana* Dana, *H. exilirostrata* Dana, *H. varians*, and *H. Prideauxiana*, together with *Virbius Australiensis*, *acutus* and *Kraussianus* Stimpson. Stimpson's *Virbius* is thus seen to include the type and all the original species of Leach's genus, and, according to common practice, it should be made a synonym of that genus and a new name given to the larger division, which includes nearly all the arctic species, of the genus as used by Kröyer. Nothing but additional synonymy and confusion would result, however, and I therefore accept the generic names as they now stand.

Hippolyte Fabricii Kröyer.

Salem Harbor!, 6 fathoms, 1873. Massachusetts Bay!, off Salem, 1877: abundant in 19 to 30 fathoms, gravelly, stony and rocky bottoms; common in 35 fathoms, mud and clay nodules, and in 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud, gravel and stones, 1877. Common on Stellwagen's Bank!, 22 to 29 fathoms, rocky, and on Jeffrey's Ledge!, 24 and 33 fathoms, gravel and

stones, 1873. Between Cape Ann and the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, and off the Isles of Shoals!, 35 fathoms, clay, mud and sand, 1874. Abundant in 7 to 35 fathoms, rocky, gravelly, shelly and muddy bottoms, at various localities in Casco Bay!, and taken also near low water mark, among eel-grass!, in Portland Harbor, and a single specimen from 48 to 64 fathoms, stones and mud, sixteen to eighteen miles east-southeast Portland Light!, 1873. Found also in abundance in the stomachs of the cod taken on West Cod Ledge!, off Portland. Bay of Fundy!, 1864, 1868, 1870, 1872, 5 to 40 fathoms, but not found in so great abundance as in Casco and Massachusetts Bays. Large females carrying eggs were also collected at Eastport!, Maine, by C. Hart Merriam and E. B. Wilson, in April, 1876. Halifax! Nova Scotia, 1877, common in 16 to 21 fathoms, stones, sand and red algæ; in 18 to 25 fathoms, shingly, gravelly, sandy and muddy bottoms; and 16 fathoms, mud, at the mouth of Bedford Basin; and a single specimen, in company with *H. macilenta*, in 35 fathoms, very soft mud, in Bedford Basin itself. Also off Halifax!, 52 fathoms, sand, mud and rocks, and 57 fathoms, gravel and stones, 1877. Gulf of St. Lawrence!, 1871, (J. F. Whiteaves). Labrador! (A. S. Packard, Jr.) Greenland (Kröyer, Norman, et al.) Bering Sea (Stimpson).

Mr. Kingsley (List of the North American Crust. belonging to the Sub-order Caridea, Bulletin Essex Institute, vol. x, p. 59, 1878) gives "Massachusetts Bay northward to Europe" for the distribution of this species, but, as this is the only record I have been able to discover of its occurrence on the eastern side of the Atlantic, I am inclined to regard it as an error, although its discovery in Europe may very properly be expected.

A careful examination of a large series of specimens of this species shows considerable variation, even in characters which are usually regarded of at least specific value. The most important of these variations which I have noticed is—

The presence or absence of epipodi upon the bases of the second pair of cephalothoracic legs. The *Fabricii* differs from all the other species of the genus which I have examined in usually wanting epipodi at the bases of all the cephalothoracic legs except the first pair, while in the other species these appendages are usually present upon the bases of the first and second or upon the first, second and third pairs; and on this character it was placed alone in a section of the genus by Kröyer. Among fifty-two individuals (eighteen males varying in length from 27 to 39^{mm}, and thirty-four females varying

from 16.5 to 50^{mm}), from various localities on the New England coast, forty-seven had the normal number of epipodi, while five had epipodi upon one or both of the second pair of legs. Three of the latter are from the Bay of Fundy: one, a male 35^{mm} long, has well-developed epipodi on each of the second pair of legs; another male, 36^{mm} long, has a short epipodus on the left side but none on the right; the other specimen, a female 47^{mm} long, has a well-developed epipodus on the right side but none on the left. The two others are from Casco Bay: a female, 36^{mm} long, with a short epipodus on the left side, and a male, 28^{mm} long, with a rudimentary one on the right side. As the measurements of these specimens show, the presence of the additional epipodi is not a characteristic of the young.

The number and position of the teeth upon the rostrum and dorsal carina of the carapax vary considerably more than is usually indicated in the descriptions of the species and yet are very characteristic specifically. Except as a result of injury, the tip of the rostrum is always acute and without teeth, and there are never teeth upon the dorsal margin except near the base. The most usual formula for the dentition is $\frac{3+1}{3}$ or $\frac{2+2}{3}$, the third dorsal tooth being usually just above the base of the rostrum; in the series of specimens examined,

Formula.	Number of specimens and variation in length.		
	Males.	Females.	Total.
$\frac{3+1}{3}$ or $\frac{2+2}{3}$	45, from 16 to 39 ^{mm}	45, from 16.5 to 50 ^{mm}	90
$\frac{3+1}{2}$ or $\frac{2+2}{2}$	14, " 15 " 35 "	16, " 15 " 40 "	30
$\frac{3+1}{4}$ or $\frac{2+2}{4}$	8, " 22 " 33.5 ^{mm}	8, " 15.5 " 50 "	16
$\frac{3+2}{3}$ or $\frac{2+3}{3}$		8, " 27 " 40 "	8
$\frac{2+1}{3}$ or $\frac{3+0}{3}$	1, 30 "	8, " 20 " 37.5 "	9
$\frac{2+1}{4}$	2, 27 and 32 "		2
$\frac{3+2}{4}$		2, 40 and 44 "	2
$\frac{2+2}{5}$		1, 31 "	1
$\frac{2+3}{6}$		1, 30 "	1
$\frac{3 \text{ to } 5}{2 \text{ to } 6}$	70	89	159

however, the number of teeth varies from three to five above and from two to six beneath, although the extremes of these variations seem to be of rare occurrence, as the accompanying tabular summary of the result of the examination of one hundred and fifty-nine specimens shows.

This result is, perhaps most noticeable for showing the constancy of what seems a very trivial character, for, among all the specimens examined, not one varies more than a single tooth either above or below the most usual number upon the dorsal carina and only two specimens (the last in the table) exceed this amount of variation in the number of teeth in the ventral edge of the rostrum.

One specimen, not included in the above summary, has the rostrum slightly distorted and bifid at the tip as seen from above,—a peculiarity undoubtedly due to injury, though there is nothing but a slight lateral distortion to indicate such a cause.

The two *spines of the anterior margin of the carapax* are usually both well-developed, but the inferior one (the pterygostomial) is occasionally very minute or even entirely obsolete. This obsolescence was noticed only in adult males, and is apparently an approach to the usual entire disappearance of the same spines among the old males of *Hippolyte polaris*.

The *dorsal aculei and terminal spines of the telson* appear to be very constant in character and number. Among seventy-five specimens examined with reference to the dorsal aculei of the telson, sixty-nine had either four or five pairs, or four upon one side and five upon the other. Of the six remaining, four are young and have less than the normal number for adults, a male 15^{mm} long and a female 16.5^{mm} having only three pairs of aculei each, another male 15^{mm} and a female 17^{mm} having each three on one side and four on the other; while a male 32^{mm} long has also less than the normal number, having three on one side and four on the other, and a female 27^{mm} has more than usual, having five upon one side and six upon the other. Fifty specimens examined with reference to the armament of the tip of the telson all had the normal number of spines,—two slender and ciliated ones in the middle with two stouter ones each side.

The largest specimens examined were taken in the Bay of Fundy, the largest males being 39^{mm} long and the largest females 50^{mm}.

The only specimens I have seen carrying eggs were collected at Eastport, Maine, in April, 1876, by Messrs. Merriam and Wilson. Among over a hundred adult females taken from July to late in October, none were carrying eggs.

Hippolyte Gaimardii Milne-Edwards.

Hippolyte Gaimardii Milne-Edwards, Hist. nat. des Crust., ii, p. 378, 1837.

Hippolyte pandaliformis Bell, History of British stalk-eyed Crustacea, p. 294 [1850?]

Hippolyte Belcheri Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, vol. ii, p. 402, pl. 34, fig. 1, 1855.

Plate IX, figures 8 and 9.

Boston Harbor, 3 fathoms, and other parts of Massachusetts Bay (Stimpson). Casco Bay!, among algæ and eel-grass near low-water mark, and also in 7 fathoms, mud and dead eel-grass, 1873. Eastport!, Maine, 1864,—one specimen only. Halifax!, Nova Scotia, 16 and 21 fathoms, stones, sand and red algæ, and 18 fathoms, fine sand and mud, 1877. Also off Halifax!, 52 fathoms, mud and fine sand, and 57 fathoms, mud and pebbles, September, 1877,—one specimen from 57 fathoms carrying eggs. Gulf of St. Lawrence!, “50 fathoms, stony and rocky,” and “56 fathoms, stones and coarse sand,” 1872 (J. F. Whiteaves). Labrador!, “common on the whole coast” (Packard). Grinnell Land, 79° 29' north latitude, (Miers). Bering Straits and Arctic Ocean (Stimpson), —*H. gibba* Kröyer. Greenland (Kröyer, et al). Iceland (Milne-Edwards, G. O. Sars). Spitzbergen (Kröyer, Miers). The whole Norwegian coast (Kröyer, et al.), the Cattegat (Kröyer), to the southern Baltic, at Kiel (Möbius, Metzger). Scotland! (Norman).

Of the twenty-five specimens which I have examined only five are males, and none of these have the remarkable dorsal prominence of the third segment of the abdomen characteristic of *H. gibba* Kröyer. None of these males, however, are over 30^{mm} long, and still in the largest of them, there is a slight carination of the third segment of the abdomen as if presaging the conspicuous character of the typical *gibba*, so that I have no reason to doubt the correctness of Goës' conclusion that Kröyer's *gibba* was based on old males of *H. Gaimardii*.

Milne-Edwards' “Troisième anneau de l'abdomen moins fortement denté,” which Stimpson (Annals Lyceum Nat. Hist. New York, x, p. 126, 1871) seems to regard as throwing doubt on the identity of Kröyer's *Gaimardii* with that of Milne-Edwards, may have referred to a young male like those just mentioned, although the fact that Milne-Edwards is comparing his species with *H. Sowerbyi* (*H. spinus*), would not necessarily imply any considerable angulation of the third segment of the abdomen. I think there is no reasonable doubt of the identity of Milne-Edwards' species with that of Kröyer and more modern authors.

The spines at the tip of the telson are normally of the same number and similar to those of *H. Fabricii*, and the terminal angle is usually very obtuse and rounded (Plate IX, figure 8). One specimen, however, out of the twenty-one in which the tip of the telson was examined, a female, 39^{mm} long, from Casco Bay, has the tip of the telson (Plate IX, figure 9) acute and armed with three small ciliated spines in the middle in place of two, so that there are seven spines in all. In other respects this specimen is perfectly normal and indistinguishable from ordinary individuals. Similar variations are noticed under *H. polaris* and *H. pusiola* and well illustrate the difficulty of stating accurately the specific characters in this genus.

Specimens taken among algæ and eel-grass in Casco Bay were, in life, translucent, slightly tinged with greenish brown, and without brightly colored markings of any kind.

Hippolyte spinus White.

Cancer spinus Sowerby, British Miscellany, p. 47. pl. 23, 1805.

Alpheus spinus Leach, "Edinburgh Encyclopedia, vii, p. 431. 1813-14" (Miers), American edit., vii, p. 271; Transactions Linnean Soc. London, xi, p. 347, 1815.

Hippolyte Sowerbei Leach, Malacostraca Podophthalmata Britanniae, pl. 39, 1817.

Hippolyte spinus White, List Crust. British Museum, p. 76, 1847.—Bell, History of British Crustacea, p. 284 [1847?]

Hippolyte spina Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 34 (103), 1860; Annals Lyceum Nat. Hist. New York, x, p. 126, 1871.

Massachusetts Bay !, off Salem, 1877; 20 to 30 fathoms, gravel and rocks, common; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules, abundant; 33 fathoms, sand and mud; 48 fathoms, soft mud. Gulf of Maine !, off Cape Ann, 1877, 50 fathoms, mud, gravel and rocks; and 90 fathoms, soft mud, common. Abundant on Stellwagen's Bank !, 29 fathoms, rocky, and on Jeffrey's Ledge !, 24 and 33 fathoms, gravel and stones, 1873. Near the Isles of Shoals !, 25 fathoms, rocky, abundant, and between the Isles and Cape Ann !, 27 to 36 fathoms, mud and rocks, 1874. Cashe's Ledge !, Gulf of Maine, 27 and 40 fathoms, gravel and rocks, very abundant; and a little south of the Ledge, 52 to 90 fathoms, rocky, 1873, 1874. Casco Bay !, 1873, among stones, at low-water mark !, on Ram Island Ledge, and common in 10 to 35 fathoms, on rocky, gravelly and shelly bottoms; taken also in 9 fathoms, mud, off Fort Georges, Portland Harbor. Very abundant in the Bay of Fundy !, 1864, 1868, 1870, 1872, 1876, on all kinds of hard bottoms in 5 to 40 fathoms; taken also, in 1872, off Whitehead, Grand Menan, 40 to 50 fathoms, gravelly bottom; west of Grand Menan, 50 to 55 fathoms, gravel;

off Head Harbor, 77 fathoms, mud and stones; and found rarely at low-water mark, under stones. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—one specimen with two of *H. securifrons*. Off Cape Negro!, Nova Scotia, 56 fathoms, large stones, 1877. Halifax!, Nova Scotia, 1877; 16 fathoms, stones, sand and red algæ; and off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand, mud and rocks, abundant; and 57 fathoms, mud and stones. Gulf of St. Lawrence!, "common on stony ground at moderate depths" (Whiteaves). Labrador! (Packard). Greenland (Krøyer, et al.). Grinnell Land, and as far north as latitude $81^{\circ} 44'$ (Miers). Bering Straits (Stimpson). Spitzbergen (Krøyer). Coast of Norway! (G. O. Sars) and of Scotland (Sowerby, Leach, et al.). This is by far the most abundant species of the genus on the New England coast.

Females carrying eggs were taken off Cape Ann, October 17; in the Bay of Fundy, at Eastport, in September or October, 1864, and, by Messrs. Merriam and Wilson, in April, 1876; one specimen off Halifax, Nova Scotia, September 5, and many September 21 and 27. I have seen no specimens taken in winter, but the period of carrying eggs undoubtedly extends from October to April or May.

In life this species is usually translucent and thickly mottled and spotted with bright red, brownish red and white, the flagella of the antennæ, the thoracic legs and the caudal appendages being annulated or banded with bright red. In some specimens the brownish red predominates and the animal is less translucent. There are other individuals in which larger or smaller portions of the cephalothorax are opaque white, these markings sometimes extending on to the abdomen or even upon the cephalothoracic appendages, but they are seldom regularly disposed and are sometimes quite unlike on the two sides of the same animal. Stimpson mentions bluish markings also, and says the antennal scales are usually blue, but I have never noticed such coloration.

Hippolyte securifrons Norman.

"*Hippolyte securifrons* Norman, Transactions Tynside Naturalists' Field Club, v, p. 267, 1863" (Danielssen and Boeck, Metzger). Norman, in Brady, Report on deep sea dredging on the coasts of Northumberland and Durham, 1862-4, Nat. Trans. Northumberland and Durham, i, p. 24, 1865; Last Report on dredging among the Shetland Isles, Report British Assoc. Adv. Sci., 1868, p. 265.—G. O. Sars. Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Magazin for Naturvidenskaberne), p. 13, 1866; Christiania Videnskabs-Selskabs Forhandling, 1871, p. 261 (18).

Hippolyte Liljeborgii Danielssen and Boeck, Beskrivelse af nogle til Crust. decapoda (extr. Nyt Magazin for Nat.), p. 8, pl., figs. 15–20, 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere for 1872, 1873, Nordsee, 290, 1865 (*Lilljeborgi*).

Plate X, figure 3.

Massachusetts Bay!: about six miles south to southeast from Gloucester, 40 to 45 fathoms, soft brown mud, 1878; about twelve miles east-southeast one-half south from Salem, 48 fathoms, soft brown mud, 1877,—common. Gulf of Maine!: about seven miles southeast by east one-half east from Cape Ann, 73 to 75 fathoms, soft mud, 1878; fourteen miles southeast from Cape Ann, 90 fathoms, soft mud, 1877,—common; about thirty miles east-southeast from Cape Ann, 85 fathoms, mud, sand and stones, 1878. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, 1873. Gulf of Maine!, seventeen miles south from Monhegan Island, 72 fathoms, brown mud, 1873; Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, and west of the Ledge, 105 fathoms, mud and gravel, 1874. Latitude $42^{\circ} 45'$ north, longitude $66^{\circ} 28'$ west, about east-southeast from Cape Sable, Nova Scotia!, 75 fathoms, fine sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, 1872. About thirty miles south of Halifax!, Nova Scotia, 101 fathoms, fine sand and mud, common, and also about one hundred and twenty miles south of Halifax, 190 fathoms, mud, 1877. West coast of Norway!, 60 to 100 fathoms (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

The males, among the specimens examined, vary from 24 to 38^{mm} in length, and the females from 26 to 58^{mm}. All the American specimens were taken in August and September, and none of the females were carrying eggs.

I have seen neither Norman's nor Danielssen's original description of this species and have identified it by comparison with English specimens received from the Rev. Mr. Norman and Norwegian specimens received from Prof. G. O. Sars. The species agrees well too with *H. Liljeborgii* Danielssen as described and figured by Danielssen and Boeck (loc. cit.). These authors state that *H. Liljeborgii* was briefly described by Danielssen in *Nyt Magazin for Naturvidenskaberne*, 1861, p. 6, thus antedating Norman's species, which they quote as a synonym. Goës, however (Efversight af Kongl. Vetenskaps-Akad. Förhandlingar, 1863, p. 170 (10)), quotes "*H. Lilljeborgi* Danielsen, Fauna litor. Norveg. nondum edita," and neither he, nor

G. O. Sars, nor Metzger refer to this early description, so that I allow the species to stand for the present under Norman's name.

Hippolyte macilenta Kröyer.

Bedford Basin!, Halifax, Nova Scotia, 26 to 41 fathoms, soft mud, common, 1877. Also off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand and mud; and 57 fathoms, mud and pebbles. Gulf of St. Lawrence!, 30 to 70 fathoms, sandy and stony bottoms, 1872, 1873 (Whiteaves). Labrador! (Packard). Greenland (Kröyer).

This species was described by Kröyer from a single specimen and I have noticed no mention of other specimens, except those of Packard and Whiteaves above referred to. The species is very distinct from the others of the genus known to me. Kröyer's description and figures apply well to medium sized females, but there is some individual variation and the young differ very considerably from the adults in the form of the rostrum. It is the most slender of our species, the carapax being scarcely thicker posteriorly than in front, and its greatest breadth only about an eighth of the length of the animal. The appendages are likewise longer and more slender than usual in the genus. In adults of both sexes the dorsum of the carapax is evenly rounded the posterior two-thirds of its length and the rostral carina rises abruptly from the anterior fourth. The rostrum is very much shorter than the rest of the carapax, scarcely reaches the tips of the peduncles of the antennulæ, is very much compressed, and ascends so that the tip is considerably above the level of the dorsum of the carapax, while the dorsal edge is strongly arcuate and dentate, very nearly its entire length, with twelve to fifteen minute teeth, which are crowded anteriorly but much more remote at the base and on the carapax. The anterior portion of the rostrum is expanded below and armed with one to four small teeth near the very slightly prominent tip. In the young the rostrum is slender, nearly horizontal, only slightly expanded vertically, terminates in an acute tip and is armed with fewer teeth than in the adult, although there are at least nine above and one below in all the specimens I have seen. There are no supraorbital spines, but well-developed antennal and distinct pterygostomial spines are present in all the specimens. The flagellum of the antenna, at least in adult males, is considerably longer than the body; two males, 41 and 43^{mm} long, each have the flagella about 50^{mm} long. The telson is much more slender than usual in the genus. In twenty specimens specially examined, there were invariably three pairs of dorsal aculei, and in fourteen speci-

mens the terminal spines were invariably (as doubtfully described by Kröyer) six in number, the median pair slender and ciliated, the submedian very long and slender, and the outer short, as usual.

None of the females examined are carrying eggs. The males are scarcely perceptibly more slender than the females. The sexual characters are well-marked, in the antennulæ and abdominal appendages, in specimens 30^{mm} long, although in specimens 26^{mm} long the secondary appendage peculiar to the male is only just making its appearance on the inner lamella of the second pair of abdominal appendages.

Locality.	Sex.	Length.	Carapax and rostrum.	Rostrum, length.	Breadth of carapax.	Rostrum, formula.
Labrador,	♀	53·mm	17·5mm	6·1mm	6·1mm	$\frac{2+13}{2}$
Gulf St. Lawrence,	"	51·	16·0	6·0	6·0	$\frac{2+12+}{4}$
"	"	47·	14·1	5·0	5·8	$\frac{2+12}{2}$
"	"	41·	13·0	5·1	5·0	$\frac{2+11}{1}$
Bedford Basin,	"	45·	14·7	6·0	5·8	$\frac{2+12}{1}$
" "	"	44·	14·4	5·9	5·2	$\frac{2+13}{2}$
" "	"	43·	13·8	5·4	5·1	$\frac{2+12}{4}$
" "	"	42·	13·3	5·3	5·2	$\frac{2+13}{1}$
" "	"	41·	13·0	5·1	4·9	$\frac{2+12}{2}$
Gulf St. Lawrence,	♂	43·	12·3	4·2		$\frac{2+10}{1}$
"	"	39·	12·2	4·3		$\frac{3+11}{3}$
Bedford Basin,	"	42·	12·6	4·9	5·1	$\frac{3+12}{2}$
" "	"	41·	12·3	4·7	5·1	$\frac{3+13}{3}$
" "	"	37·	11·3	4·4	4·8	$\frac{3+12}{2}$
Off Halifax,	"	29·	9·0	3·3	4·7	$\frac{2+9}{1}$
"	"	27·	8·7	3·2	3·8	$\frac{2+9}{2}$
"	"	26·	8·0	2·9	3·7	$\frac{2+8}{1}$
"	"	24·	7·1	2·4	3·6	$\frac{2+7}{1}$
Gulf St. Lawrence,	"	23·	7·2	2·5	3·4	$\frac{2+7}{1}$
"	"	22·				$\frac{2+7}{1}$
"	"	21·				$\frac{2+7}{1}$

The preceding table gives measurements* and the dental formula for the rostrum of some of the specimens from different localities.

Hippolyte Phippsii Kröyer.

Hippolyte Phippsii Kröyer, Naturhistorisk Tidsskrift, iii, p. 575, 1841 (♂).

Hippolyte turgida Kröyer, loc. cit., p. 575, 1841 (♀).

Hippolyte vibrans Stimpson, Annals Lyceum Nat. Hist. New York, x, p. 125, 1871 (♂, var.)

? *Hippolyte Ochotensis* Brandt, in Middendorff's Sibirische Reise, ii, p. 120, pl. 5, fig. 17, 1849 (♀).

Massachusetts Bay!, off Salem, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud and gravel, 1877. Off the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, 1874. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 40 fathoms, 1874,—27 males and 24 females. Near Cashe's Ledge!, 52 to 90 fathoms, rocky, 1873. Casco Bay!, 10 to 22 fathoms, rocky, near West Cod Ledge, 1873. Eastport!, Bay of Fundy, 18–25 fathoms, rocks and shells, 1868, 1870. Grand Menan!, Bay of Fundy, 1872 (Prof. H. E. Webster). Halifax!, Nova Scotia, 1877: 16 fathoms, fine sand and red algæ; 18 fathoms, fine sand; 25 fathoms, rocks and nullipora; 25 fathoms, gravel; and 26 to 41 fathoms, soft mud, in Bedford Basin,—a single specimen. Gulf of St. Lawrence! (J. F. Whiteaves): off Trinity Bay, 90 fathoms, small stones and coarse sand, and off Cape Rosier Light, 125 fathoms, mud, 1871; Orphan Bank, 1873. Labrador! (A. S. Packard, Jr.) Grinnell Land and as far north as latitude 81° 44' (Miers). Greenland (Kröyer, Stimpson, et al.). Arctic

* In these measurements, as in all those which I give of *Macrura* and *Schizopoda*, the *length* is from the tip of the rostrum to the tip of the telson while the abdomen is extended nearly straight with the carapax; the *length of the carapax* and rostrum is from the tip of the rostrum to the middle of the posterior margin; the *length of the rostrum* is from the tip to the posterior margin of the orbit; the *breadth of the carapax* is at the widest point—a measurement which varies with the state of contraction more than the others. The length of the rostrum as measured above may be very slightly too great, particularly if the rostrum be relatively short, since it is not perfectly parallel with the longitudinal axis, but it has the practical advantage of being between definite points—a matter of the utmost importance. The length of the carapax exclusive of the rostrum is taken from the posterior margin of the orbit to the middle of the posterior margin, but is found accurately enough by subtracting the length of the rostrum from that of the carapax and rostrum. If the rostrum is very short it is better to measure the length of the carapax exclusive of the rostrum and find the length of the rostrum by subtraction.

Ocean and Bering Straits (Stimpson). ? Sea of Ochotsk (Brandt) and the island of Jesso (Stimpson)—*H. Ochotensis*. Spitzbergen (Kröyer). Coast of Norway ! (G. O. Sars).

The examination of a large series of specimens shows conclusively that Kröyer's *H. turgida* is only the full-grown female of his *Phippsii*, as suggested by Goës, and that Stimpson's *vibrans* is a mere variety without any real claim to specific rank. Kröyer included young females under his *Phippsii*, as he distinctly states he had both sexes of that species, and it is not strictly true, as Goës implies, that all the males fall under one of Kröyer's species and all the females under the other, for the young males and young females are almost indistinguishable, except by the essential sexual characters, and agree with Kröyer's description of *Phippsii*. As in many similar cases of great differences in the sexes, the relation of the two forms may be easily established, with sufficient specimens, by tracing the forms back in two series toward the young, where the secondary sexual characters disappear and the two forms are seen to be specifically identical. In the present case the smallest females in which the sex is easily distinguishable differ scarcely at all in the form of the rostrum and in the other characters which Kröyer gives as characteristic of the two species.

I have never seen males which could be regarded as agreeing well with the characters of *turgida* as given by Kröyer, and I cannot explain the statement of Buchholz (who retains both Kröyer's species though regarding them as probably varieties of one species) that he had, from East Greenland, two males of *H. turgida*, 30 to 35^{mm} in length, without supposing some mistake in the determination of the sex of the specimens,—a supposition which I have no sufficient reason for hazarding.

The only characters which Stimpson gives for distinguishing his *H. vibrans*, found in Massachusetts Bay, from the *Phippsii* of Kröyer are that it has "but one spine over the eye," and that there are "only two or three teeth beneath the tip of the rostrum." The lower of the two supraorbital spines each side is really very small when best developed; it is not at all constant, there being a complete gradation between specimens in which it is well-developed and those in which it is entirely absent; and it often varies considerably on the two sides of the same individual. The number of teeth on the inferior edge of the rostrum is of even less importance as a distinguishing character, for three or four is the usual number in the typical *Phippsii* and specimens with only two beneath the rostrum

often have both pairs of supraorbital spines well-developed, so that the two characters do not even accompany each other. This variety is evidently the form of which Miers (Annals and Magazine Nat. Hist., iv, xx, p. 62 (12), 1877) had a single specimen from Cape Frazer, Grinnell Land, and to which he refers under *H. Phippsii*?

The following table exhibits these variations in a series of specimens selected from a much larger number. In the last column I have attempted to indicate the variation in the supraorbital spines, although it is impossible to express in words the completeness of the gradation between those individuals in which the lower spine is fully developed and those in which it is entirely wanting.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Grand Menan,	♂	24.5mm	$\frac{3+6}{4}$	Two well-developed.
"	"	24.3	$\frac{4+5}{3}$	" "
"	"	25.0	$\frac{4+6}{2}$	Two, one very minute.
"	"	25.5	$\frac{4+5}{3}$	One only.
"	"	25.2	$\frac{4+5}{2}$	One, with rudiment of 2d.
"	"	24.3	$\frac{4+6}{4}$	One only.
"	"	21.8	$\frac{3+7}{3}$	" "
Cashe's Ledge,	"	19.2	$\frac{2+6}{2}$	Two well-developed.
"	"	17.0	$\frac{0+6}{2}$	Two, one very small.
"	"	15.5	$\frac{3+5}{2}$	" " "
"	"	18.5	$\frac{3+6}{2}$	Two, one scarcely percepti- [ble.
"	"	17.5	$\frac{3+5}{4}$	One only.
"	"	17.1	$\frac{4+6}{4}$	" "
"	"	17.0	$\frac{3+6}{3}$	Two.
"	"	16.0	$\frac{4+6}{2}$	One.
"	"	16.5	$\frac{3+7}{3}$	"
Isles of Shoals,	"	16.7	$\frac{3+6}{4}$	Two, one scarcely percepti- [ble.
Cashe's Ledge,	"	16.5	$\frac{3+7}{3}$	One.
"	"	15.5	$\frac{3+5}{2}$	Two well-developed.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Cashe's Ledge,	♂	15.0mm	$\frac{3+7}{3}$	Two.
"	"	14.3	$\frac{3+5}{2}$	Two, one very small.
Halifax,		12.0	$\frac{2+3}{1}$	One only!
"	♀	17.5	$\frac{4+7}{3}$	Two, one very small.
Mass. Bay,	"	18.0	$\frac{3+6}{4}$	Two, one scarcely perceptible.
Cashe's Ledge,	"	19.0	$\frac{4+5}{4}$	One only!
"	"	21.8	$\frac{3+6}{4}$	Two well-developed.
"	"	21.3	$\frac{4+7}{6}$	" "
"	"	24.0	$\frac{4+4}{5}$	" "
Norway,	"	22.6	$\frac{4+6}{7}$	" "
Casco Bay,	"	29.0	$\frac{3+5}{6}$	" "
Grand Menan,	"	32.6	$\frac{4+6}{5}$	" "
"	"	35.5	$\frac{4+6}{5}$	" "
"	"	37.0	$\frac{4+6}{4}$	" "

The form of the telson and the number of its dorsal aculi and terminal spines was usually very constant in all the specimens examined. In thirty-five out of forty-four individuals there were four pairs of aculi, or four upon one side and five upon the other: of the remainder, six (two males, 21 and 26^{mm} long, and four females, 19 to 36.5^{mm} long) had five pairs; a male of 25^{mm}, five upon one side and six upon the other; a female of 37^{mm}, four upon one side and three upon the other; and a female of 25.5^{mm}, only three pairs. In thirty-seven specimens in which the spines of the tip were specially examined, only one (a female 36^{mm} long, from Halifax, Nova Scotia, and in all other respects perfectly normal) varied from the normal number, this specimen having three small ciliated spines in the middle in place of the two in normal specimens. This is a case precisely similar to that noticed under *H. Gaimardii*, and figured on Plate IX, figure 9, except that in this case there seems to be no variation whatever in the form of the terminal margin itself.

In life the males at least are semi-translucent, and specked and irregularly mottled with obscure brownish red on the carapax and appendages.

Hippolyte pusiola Kröyer.

Plate IX, figures 4, 5, 6, 7.

Off Block Island!, 8 to 10 fathoms, rocky, 1874. Off Stonington!, Connecticut, 4 to 5 fathoms, rocky, 1873 (A. E. Verrill and D. C. Eaton). Vineyard Sound!, 2 to 12 fathoms, gravelly and shelly, not common, 1871 and 1875. Off Nantucket!, 15 fathoms, 1875. Massachusetts Bay!, off Salem, 1877, 20 fathoms, rocks and gravel; 35 fathoms, mud and clay nodules; 48 fathoms, soft mud,—one specimen. Off Cape Ann!, 50 fathoms, mud, gravel and rocks, 1877. Also, Salem Harbor!, 4 fathoms (J. H. Emerton). Casco Bay!, 1873, at low-water mark!, among stones, on Ram Island Ledge; also at numerous localities in from 4 to 33 fathoms, rocky and gravelly, or "hard" bottoms, and abundantly in the stomachs of the cod taken on West Cod Ledge!. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 39 fathoms, rocks and gravel, 1874,—abundant; abundant also near the Ledge!, in 52 to 90 fathoms, 1873. George's Bank!, 45 fathoms, coarse sand, 1872,—one specimen. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: not uncommon at low-water mark!, among stones and algæ; common in 5 to 50 fathoms, rocky, gravelly and shelly bottoms; off White Head, Grand Menan, 97 to 105 fathoms, gravelly, 1872. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—abundant. Halifax, Nova Scotia!, 1877: 16 fathoms, rocky; 18 fathoms, fine sand; 25 fathoms, gravel; and one specimen also from 16 fathoms, mud. Gulf of St. Lawrence!, Orphan Bank and, in 10 fathoms, gravel, stones and broken shells, off Sea-Cow Head, Prince Edward Island, 1873 (J. F. Whiteaves). Iceland (G. O. Sars). Lofoten Islands!, coast of Norway (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

I have not been able to discover any authentic record of the occurrence of this species in Greenland. The statement, by Prof. Verrill and myself, in the Report on the Invertebrate Animals of Vineyard Sound, pp. 396 (102) and 550 (256), that it extends to Greenland, was made without any authority, and the including of Greenland in its geographical range by Kingsley (Bulletin Essex Institute, vol. x, p. 59), is probably due to our error, although Mr. Kingsley gives no authority for his statement. The species has, however, an extensive northern range, and will very likely yet be found in Greenland.

Out of one hundred and six specimens in which the rostrum was specially examined, ninety-two (among which the males varied from

10.5 to 17^{mm} in length, and the females from 13 to 23^{mm}) had either three or four teeth on the dorsal edge of the rostrum, and none at the tip or beneath; and this is evidently the normal rostral dentition of the species, although the fourteen remaining specimens show considerable deviation from this typical form. Of these fourteen specimens, nine) all females from off Nantucket, from the Bay of Fundy, and from Halifax, Nova Scotia, and varying from 19 to 25^{mm} in length), have four teeth above and one beneath the tip, and three of these nine, all females from the Bay of Fundy, and each about 23^{mm} in length, have the inferior tooth so near the tip that the tip is best described as bifid; one female, 22^{mm} long, from the Bay of Fundy, is similarly armed at the tip but has only three teeth above; one female, 16^{mm} long, from Halifax, Nova Scotia, has five distinct teeth above but none below; while three males, 12 to 13.5^{mm} long, from Casco Bay and Cashe's Ledge, have only two teeth above. This would seem to show that a tendency to an increase in the number of rostral teeth is characteristic of the females, while the reverse is the case in respect to the males.

The usually very constant arrangement of the terminal spines of the telson is occasionally subject to variation, which apparently follows the same tendency in the sexes as the variation in the number of rostral teeth, although the number of observations in either case is too small for a reliable generalization. Of forty-eight specimens in which the tip of the telson was specially examined, forty-five (among which the males varied from 12 to 17^{mm} in length, and the females from 14 to 25^{mm}), had the normal number of terminal spines; that is, • a short one at the lateral angle each side, two much longer ciliated ones in the middle, and, between these and the lateral spines each side, a still longer and stouter spine, making six in all (Plate IX, figure 7). Of the remaining specimens, a male 17^{mm} long, from the Bay of Fundy, has but one median ciliated spine, so that there are only five in all (Plate IX, figure 6); and yet there is not the slightest appearance of this irregularity being due to injury, and the specimen is in all other respects perfectly normal. A female 20.5^{mm} long, from the Bay of Fundy, has nine spines, of which the three median are ciliated (Plate IX, figure 4); there is a little irregularity in the spines, apparently due to some slight injury. Another female 16^{mm} long, from Halifax, Nova Scotia, has also nine spines, of which the five central ones were probably ciliated, although, apparently on account of the imperfect state of preservation of the specimen, I was able to discover cilia on only a part of them, as shown in the figure

(Plate IX, figure 5). In this last specimen there is evidence of injury in the irregular outline of one of the lateral angles of the tip of the telson, in the irregularity of the spines, and particularly in the supplemental group of three aculei near this irregular angle as shown in the figure.

The largest specimens examined are from the Bay of Fundy, the largest male being 17^{mm} in length, and the largest female 25^{mm}.

The color in life varies considerably, as the following notes, unfortunately all made upon adult females, show. A specimen, taken among stones and algæ at low-water mark at Eastport, Maine, was translucent specked upon the body and appendages with bright red, and with a white dorsal line extending from the tip of the rostrum to the telson. Another, dredged at Eastport, in 20 to 25 fathoms, rocky and shelly bottom, was faintly specked with pale red on the carapax and the sides of the abdomen; the antennæ, antennulæ and cephalothoracic legs annulated and the abdominal legs, telson and the uropodal lamellæ banded with the same color. Still another specimen, from 40 to 50 fathoms, rocky bottom, at Eastport, was much more brilliantly colored, though after the same pattern: the eye-peduncles and the bases of the antennulæ, antennæ and cephalothoracic legs were thickly specked with bright red, the distal portions of the legs and the flagella of the antennulæ and antennæ were closely annulated, while the antennal scales, carapax and abdomen were transversely banded with the same color; the band upon the sixth segment of the abdomen and that across the telson and uropodal lamellæ were nearly as broad as the length of the sixth segment and the telson respectively, and very deep bright red. A considerable number of specimens taken among stones and red algæ upon the Cod Ledges, Casco Bay, were very brightly colored, much in the same way as the last specimen. According to notes made by Professor Verrill in 1870, two specimens dredged in 15 fathoms, stony bottom, north of Treat's Island, Eastport Harbor, differed considerably in color; one was pale flesh-color with a median dorsal stripe of whitish and the sides speckled with pale red, the flagella of the antennulæ and antennæ having alternate bands of pale reddish and flesh-color, and the legs thickly speckled with light brownish and obscurely banded with the same; while the other specimen was pale grayish, with about five transverse whitish bands on the abdomen, and a dark gray band across the sixth segment and another across the telson and uropodal lamellæ, and with the cephalothoracic legs banded with white and gray.

Females carrying eggs are abundant in all the collections I have

examined; these collections have been made in July, August, September, October and April, so that the species evidently breeds during a large portion of the year.

Hippolyte polaris Ross.

Alpheus polaris Sabine, in Supplement to appendix of Parry's [first] Voyage, p. ccxxxviii, pl. 2, figs. 5-8, 1824.

Hippolyte polaris J. C. Ross, in John Ross, Appendix to narrative of a second Voyage in search of the northwest passage, p. lxxxv, 1835 (♀).

Hippolyte borealis J. C. Ross, in John Ross, op. cit., p. lxxxiv, pl. B, fig. 3, 1835 (♂).

? *Hippolyte cultellata* Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Sci., 1866, p. 200, 1867; Last Report on dredging among the Shetland Isles, op. ult. cit., 1867, p. 265.

Plate XI, figures 1 to 4.

Massachusetts Bay!, off Salem, 1877: 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud [*a*]. Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873 [*b*]. Casco Bay!, 1873 [*c*]: near West Cod Ledge, 10 to 15 fathoms, rocky, and from stomachs of the cod taken at the same locality. Also off Seguin Island!, 48 fathoms, gravel, 1873 [*d*]. Cashe's Ledge!, 30 to 40 fathoms, gravel [*e*]; and near the Ledge, 65 fathoms, mud and gravel, 1874 [*f*]. Bay of Fundy!, 1870, 1872 [*g*]. About east-southeast from Cape Sable, Nova Scotia!, north latitude $42^{\circ} 45'$, west longitude $66^{\circ} 27'$, 75 fathoms, fine sand and mud, 1877 [*h*]. Off Cape Negro!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Halifax!, Nova Scotia, 1877: 16 fathoms, rocks, and stones and red algæ [*i*]; 18 fathoms, fine sand [*k*]; and 25 fathoms, gravel. Off Halifax!, 1877: 25 fathoms, rocks and nullipora [*l*]; 52 fathoms, fine sand and mud; and 100 fathoms, fine sand [*m*]. Gulf St. Lawrence! (Whiteaves, 1871). Labrador! (Packard). Grinnell Land (Miers). Greenland (Kröyer, et al.), as far north as $81^{\circ} 44'$ (Miers). Arctic Ocean, north of Bering Straits (Stimpson). Spitzbergen (Kröyer, Miers). West coast of Norway! (G. O. Sars) [*n*]. North Sea (Metzger). ? Shetland Islands (*H. cultellata* Norman).

This species presents another case of differences between certain individuals among the adult males, or perhaps more properly old males, on the one hand, and the females and younger males, on the other hand; that is, the *borealis*-form bears much the same relation to the original *polaris* as *gibba* does to *Gaimardii*, and a relation somewhat similar to that of *Phippisii* to *turgida*. The specimens before me show a very complete series connecting the most characteristic form of *borealis* with the ordinary forms of *polaris*. Of the spe-

cimens examined, all the males 28^{mm} or less in length have well-developed rostral teeth and a distinct spine (the pterygostomian) at the inferior angle of the anterior margin of the carapax, and in these characters agree fully with the female. In all the specimens much above 30^{mm} in length the pterygostomian spines are small, rudimentary or wanting, though they do not seem to disappear wholly at any particular size of the individual. The disappearance of the dorsal teeth of the rostrum is still more irregular and is evidently a character peculiar to, but not characteristic of, the adult male. There are often very rudimentary teeth present which could not be discovered without the aid of a lense, and the gradation between the forms in which they are well-developed and those in which they are wholly wanting is most complete. That the form of male with edentulous rostrum and without pterygostomian spines has no claim to be retained as a species is conclusively shown, (1) by the complete gradation in these characters between this form and the original *polaris*-form, (2) by the fact that one of the characters may exist without the other in the same individual, and (3) by the negative evidence that there is no corresponding female form.

The following tabulation of the character of the rostral teeth and the pterygostomian spines, together with the length of the individual and the rostral formula, in a series of specimens selected from a much greater number, exhibits some of the variations. The letters indicating the localities correspond with those in brackets under the distribution of the species given above.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomian spine.
k_1		23.7mm	$\frac{2+3}{2}$	Well-developed.	Well-developed.
k_1		24.0	$\frac{2+2}{2}$	"	"
k_1	♂	25.0	$\frac{2+3}{3}$	"	"
l_1	"	25.7	$\frac{2+3}{2}$	"	"
f_1	"	26.0	$\frac{2+5}{3}$	"	"
c_1	"	26.5	$\frac{2+4}{2}$	"	"
f_1	"	27.0	$\frac{2+5}{4}$	"	"
b_1	"	28.0	$\frac{2+2}{2}$	"	"
k_1	"	30.0	$\frac{2+3}{3}$	"	"
c_1	"	32.0	$\frac{2+2}{3}$	"	Small.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomian spine.
<i>k</i> , σ		34.0mm	$\frac{2+3}{4}$	Well-developed.	Rudimentary.
<i>g</i> , "		35.4	$\frac{2+4}{3}$	"	Very small.
<i>f</i> , "		39.5	$\frac{3+5}{4}$	"	Scarcely perceptible.
<i>g</i> , "		43.0	$\frac{2+3}{2}$	Very small.	Rudimentary.
<i>b</i> , "		32.0	$\frac{? ?}{3}$	Scarcely perceptible.	Small.
<i>b</i> , "		33.0	$\frac{? ?}{3}$	Very minute.	Absent?
<i>m</i> , "		34.0	$\frac{2+3}{4}$	Very small.	Wholly absent.
<i>n</i> , "		36.0	$\frac{2?+3?}{4}$	Very minute.	Wholly absent.
<i>h</i> , "		37.0	$\frac{? ?}{2?}$	Scarcely perceptible.	Wholly absent.
<i>e</i> , "		30.0	$\frac{0+0}{3}$	Absent.	Very rudimentary.
<i>e</i> , "		31.0	$\frac{0+0}{3}$	"	Very rudimentary.
<i>e</i> , "		32.0	$\frac{0+0}{0?}$	"	Wholly absent.
<i>k</i> , σ		29.4	$\frac{2+3}{3}$	Well-developed.	Well-developed.
<i>k</i> , "		31.0	$\frac{3+3}{3}$	"	"
<i>e</i> , "		33.0	$\frac{2+3}{3}$	"	"
<i>e</i> , "		33.5	$\frac{2+2}{2}$	"	"
<i>g</i> , "		35.0	$\frac{2+4}{4}$	"	"
<i>c</i> , "		40.0	$\frac{2+3}{2}$	"	"
<i>i</i> , "		41.0	$\frac{2+3}{3}$	"	"
<i>n</i> , "		42.4	$\frac{2+2}{4}$	"	"
<i>n</i> , "		45.0	$\frac{2+5}{3}$	"	"
<i>n</i> , "		48.0	$\frac{3+4}{3}$	"	"
<i>n</i> , "		49.0	$\frac{2+4}{5}$	"	"
<i>l</i> , "		55.0	$\frac{2+3}{3}$	"	"
<i>d</i> , "		55.0	$\frac{2+3}{2}$	"	"
<i>g</i> , "		56.0	$\frac{2+4}{3}$	"	"
<i>a</i> , "		56.0	$\frac{2+3}{3}$	"	"

The number of dorsal aculei upon the telson varies from four to ten pairs. The greatest number noticed being in the case of two females 48 and 49^{mm} in length, from the coast of Norway; the smallest number, in males 27 to 35^{mm} long and females 31 to 34^{mm}, from our own coast. That the number has no very close relation to the size of the individual is shown by a male 34^{mm} long having six aculei on one side and eight upon the other; while the largest specimen examined, a female 56^{mm} long, from the Bay of Fundy, has four upon one side and five upon the other. In thirty specimens from New England, Nova Scotia and the coast of Norway, the terminal spines of the telson are as described by Kröyer, that is four median ciliated ones and two stouter each side, making eight in all. A single female specimen, 31^{mm} long, from Labrador, differs however in having five median ciliated spines with two stouter spines each side, making nine in all,—a case precisely similar to that mentioned under *H. Gaimardii*.

The following notes on the color while living were made by Professor Verrill on an adult female, from 12 fathoms, Johnson's Bay, Bay of Fundy, 1870. Body pale flesh-color, beautifully spotted and barred transversely with orange-brown, the abdomen with somewhat rounded, unequal spots which tend to form transverse bars above, but on the second, third and fourth segments there is a regular band of this color. The carapax is spotted on the sides with orange-red and sparingly with sulphur-yellow; the upper portion bluish green, finely speckled with brown and yellow, and with three lateral spots on each side and two median of bright blue. Between the eyes and passing obliquely backward is a stripe of red. On the sides of the abdomen are five specks of sulphur-yellow and above these are two small bright blue spots on the fifth segment and a median one with two smaller each side on the second. The telson and uropodal lamellæ are brownish at base, behind which there is a sulphur-yellow band bordered with white, the rest of the lamellæ speckled with brown, and the outer ones with a semi-circular spot of dark purplish brown near the middle of the outer margin. The flagella of the antennæ are salmon-color banded with orange-red. The first pair of cephalothoracic legs are red at base and on the terminal segments; the second are banded with red near the base and at the tip; the third and fourth are red at base, then banded with yellow, whitish and dark brown alternately, and the terminal segments flesh-color; the posterior pair are similar but have a sulphur-yellow base. The abdominal legs are flesh-color, spotted and transversely banded with dark red and sulphur-yellow.

Males when not more than 25^{mm} in length show distinctly the sexual characters in the first and second pairs of abdominal legs, and they arrive at sexual maturity at a little over 30^{mm} in length, if not earlier, since two specimens which I have examined, 34 and 37^{mm} long, have the sperm ducts, or spermatophores extruded,—probably a result of the contraction due to the preservation of the specimens in alcohol. Among four females carrying eggs the smallest is about 40^{mm} in length. These four, the only specimens seen with eggs, were all taken in 16 to 100 fathoms, at and off Halifax, Nova Scotia, September 4, 5, 6, 1877.

Since some, even recent, authors have apparently had difficulty in distinguishing with certainty the sexes in the species of *Hippolyte*, I introduce figures of the first pair of abdominal appendages and of the inner lamella of the second pair in the male and female of this species, to illustrate the sexual differences in these appendages in the genus. (Plate XI; figure 1, appendage of the left side of the first segment of the male; figure 3, corresponding appendage of the female; figure 2, inner lamella of the appendage of the left side of the second segment of the male; figure 4, corresponding part of the appendage of the female). At least in all the species of *Hippolyte* mentioned in this paper, the differences in these appendages in the two sexes are very similar to those shown in these figures, and are so conspicuous that they afford the readiest means for distinguishing the sexes, which is easily done at a glance.

In the first pair of abdominal appendages of the female, both lamellæ are furnished with long plumose setæ upon each margin to the very tip, as in the succeeding appendages; the outer lamella is always much narrower than the more or less ovate inner one and is linear in outline. In the male the basal portion of the appendage is relatively smaller than in the female; the outer lamella is similar to that in the female, but very much larger, and even larger than the inner lamella in the male; this inner lamella always tapers rapidly into a slender terminal portion which is naked, except a few minute, very short, modified and hook-like spines at the very tip; the margins toward the base, however, are furnished with short setæ or slender spinules, but entirely want the long plumose setæ so characteristic of the corresponding parts of the other appendages.

In the second pair of abdominal appendages, the differences are mostly confined to the inner lamellæ, which are narrowly ovate, and margined with long, plumose setæ in both sexes, but in the female there is, arising from the proximal half of the inner margin,

a single, slender process which is entirely naked except at the tip, where it is armed with numerous modified spines like those upon the tip of the inner lamella of the first pair of appendages in the male; while in the male there is a similar process, usually arising nearer the base, however, but always accompanied by a somewhat smaller process arising just at the base of the first and furnished with numerous long setæ like the marginal setæ of the lamella itself.

Hippolyte Grœnlandica Miers.

Astacus Grœnlandicus J. C. Fabricius, *Systema Entomologiæ*, p. 416, 1775; *Entomologia systematica*, ii, p. 484, 1793.

Cancer aculeatus O. Fabricius, *Fauna Grœlandica*, p. 239, 1780.

Alpheus aculeatus Sabine, in Supplement to appendix of Parry's [first] Voyage, p. cccxxviii, pl. 2, figs. 5-8, 1824.

Hippolyte aculeata J. C. Ross, in John Ross. Appendix to narrative of a second Voyage in search of the northwest passage, p. lxxxiii, 1835.

Hippolyte armata Owen, Voyage of the Blossom, p. 88, pl. 27, fig. 2, 1839 (♀).

Hippolyte cornuta Owen, op. cit., p. 89, pl. 28, fig. 2, 1839 (♂).

Hippolyte Grœnlandica Miers. *Annals and Magazine Nat. Hist.*, IV, xx, p. 62 (12), 1877.

Salem Harbor!, Massachusetts, 6 fathoms, 1873; also off Baker's Island!, 20 fathoms (J. H. Emerton, 1878). Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873. Casco Bay!, 1873: between Overset and Peak's Islands, 18 fathoms, rocks and sponges; West Cod Ledge, 10 to 20 fathoms, rocky; and from the stomachs of cod taken at the last locality. Grand Menan!, Bay of Fundy, 1872; also off Flagg's Cove!, Grand Menan, 15 fathoms, shells, mud and stones, 1873. Off Treat's Island!, Eastport, Maine, 15 fathoms, stones, 1870. Halifax!, Nova Scotia, 1877: 16 fathoms, stones, sand and red algæ; 18 fathoms, fine sand, also mud and fine sand; 21 fathoms, fine sand and red algæ; and 25 fathoms, gravel. Murry Bay!, Gulf of St. Lawrence (Principal J. W. Dawson). Labrador (Packard). Grinnell Land, as far north as 82° 30' (Miers). Greenland (J. C. Fabricius, O. Fabricius, Krøyer, et al.). Bering Sea and Arctic Ocean north of Bering Straits (Owen, Stimpson).

The largest specimens examined were from the Bay of Fundy, the largest male 41^{mm}, the largest female 55^{mm} in length.

According to the following notes, made by Professor Verrill in 1870, on two males from the Bay of Fundy, this species varies considerably in coloration. A male 41^{mm} long, from 15 fathoms, stony, north of Treat's Island, Eastport Harbor, had the body very pale whitish gray with faint clouds of dark gray on the carapax and a large spot of the same color on each side of each of the first five seg-

ments of the abdomen, those on the first three segments connected by a transverse dorsal band of the same, which, however, was narrowly interrupted in the middle on the first two segments. Flagella of the antennæ and antennulæ annulated with wide alternate bands of light red and white. Teeth of the rostrum dark brownish. Cephalothoracic legs white, annulated with pale red or flesh-color. Caudal lamellæ mottled with gray.

In the other specimen, 37^{mm} long, from 10 fathoms, shells, mud and stones, Flagg's Cove, Grand Menan, the carapax was flesh-color specked and mottled with light red, dorsal teeth and rostrum thickly specked with darker red, and the posterior border with two spots of the same color. The first three segments of the abdomen with broad interrupted transverse bands of light red; the posterior segments and caudal appendages mottled and specked with the same. Flagella of the antennulæ and antennæ, and the cephalothoracic legs as in the other specimen.

Pandalus borealis Krøyer.

Massachusetts Bay!, about twelve miles east-southeast from Salem, 45 to 50 fathoms, mud, 1877, and also in 1878,—very abundant. Gulf of Maine!, off Cape Ann, 40 to 98 fathoms, mud, 1877, 1878,—very abundant, particularly in a region about fourteen miles southeast from Cape Ann, in from 50 to about 100 fathoms. East of Jeffrey's Ledge!, 114 fathoms, soft mud, 1873. Gulf of Maine!, about forty miles east of Cape Ann, 160 fathoms, 1877. Off Casco Bay!, eighteen to twenty miles southeast from Cape Elizabeth, 48 to 68 fathoms, mud, 1873,—common. Twenty to thirty miles southeast to southeast one-half east from Cape Sable, Nova Scotia!, 59 to 88 fathoms, fine sand, pebbles and rocks, 1877,—two small specimens. About thirty miles south to south by west one-fourth west from Halifax!, Nova Scotia, 85 to 110 fathoms, fine sand and mud, 1877. Greenland (Krøyer). Bering Sea (Brandt), Norway! (G. O. Sars), and south to the Cattegat (Goës).

According to notes made by Professor Verrill in 1877, this species when living is "thickly sprinkled with small red stellate spots, which, from closer aggregation, make the tail deeper in color than the rest of the body. Flagella of the antennulæ annulated with very narrow white rings alternating with very broad red bands. Flagella of antennæ deep red. Spermaries purplish red, the outer membrane golden. Ovaries blue. Eggs ultramarine blue."

Females carrying eggs were taken in August and September, 1877 and 1878, in and off Massachusetts Bay and off Cape Ann.

Pandalus Montagu Leach.

Pandalus Montagu Leach, "Edinburg Encyclopedia, vii, p. 432" (teste White), 1813 or 1814; American Edition, vii, p. 271.—White, Catalogue of British Crustacea in British Museum, p. 41, 1850.

Pandalus annulicornis Leach, Malacostraca Podophthalmata Britanniae, pl. 40, March, 1815; Transactions of the Linnean Society, London, xi, p. 346, 1815.

Pandalus levigatus Stimpson, Marine Invertebrata of Grand Manan, p. 58, 1853.

Vineyard Sound!, in deep water off Gay Head, 1871; also off Buzzard's Bay!, 25 fathoms, and off Newport!, Rhode Island, 29 fathoms, 1871. At these localities south of Cape Cod, the species was rare and all the specimens of small size. Massachusetts Bay!, off Salem, 22 to 48 fathoms, gravelly, sandy and muddy bottoms, 1877, common. Also 45 fathoms, soft mud, off Cape Ann!, 1878. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy, 1873. Gulf of Maine!, off Cape Ann, 75 and 90 fathoms, mud, 1877,—common and very large, and associated with *P. borealis*. Common on St. George's Banks!, in 28 fathoms, coarse sand; 30 fathoms, soft sand; 50 and 60 fathoms, sand and shells; and 45 fathoms, coarse sand, 1872. Also east of St. George's Banks!, 430 fathoms, sand, gravel and stones, 1872,—several specimens, unquestionably of this species. Casco Bay!, common in 10 to 45 fathoms, rocky, shelly, gravelly, sandy, and muddy bottoms, and in abundance in the stomachs of the cod taken on the Cod Ledges, 1873. Also off Casco Bay!, eighteen to twenty miles southeast of Cape Elizabeth, 48 to 68 fathoms, mud, 1878,—large individuals associated with *P. borealis*. Bay of Fundy!, 10 to 77 fathoms, 1864, 1868, 1870, 1872, 1876,—very common. About east-southeast from Cape Sable!, Nova Scotia, north latitude $42^{\circ} 45'$, west longitude $66^{\circ} 27'$, 75 fathoms, fine sand and mud, 1877. Halifax!, Nova Scotia, 16 to 25 fathoms, on bottoms of stones and red algæ, gravel, and fine sand and stones, 1877. In Bedford Basin!, Halifax, 26 to 41 fathoms, soft mud, 1877,—two specimens. About ten miles off Halifax, 53 fathoms, sand, mud and rocks, 1877. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Krøyer et al.). Iceland (G. O. Sars). Scandinavian coast! (G. O. Sars) and British Isles! (Norman et al.).

The largest specimens examined are from 90 fathoms, off Cape Ann, and are 115^{mm} long. There are specimens over 100^{mm} long from

other localities in the Gulf of Maine, from off Casco Bay, 48 to 68 fathoms, and from deep water in the Bay of Fundy.

In examining many hundreds of specimens only seven were found carrying eggs; these specimens vary between 75 and 100^{mm} in length: one of them is from 48 fathoms, Massachusetts Bay, August 13, 1877; another is from 45 fathoms, in the same region, August 29, 1878; three are from 75 fathoms, Gulf of Maine, off Cape Ann, October 17, 1877; and two are from Halifax, Nova Scotia, September, 1877.

This species differs in color from the *borealis* in having the red more intense and arranged in clearly defined markings, of which those upon the carapax and abdomen are arranged in conspicuous, obliquely transverse lines or bars, while the color upon the rest of the body and upon the appendages is collected in distinct specks, blotches, or annulations.

Stimpson's *Pandalus levigatus* is undoubtedly synonymous with *P. Montagu*. The latter species is exceedingly abundant in the Bay of Fundy and Dr. Stimpson could scarcely have failed to obtain it in his dredgings at Grand Menan. Moreover, the description of the *levigatus* applies perfectly to the *Montagu*, except as to the color, in regard to which there was probably some mistake. There are similar discrepancies in regard to the color of some of the species of Amphipoda described in the same memoir.

Palæmonetes vulgaris Stimpson ex Say.

Kingsley (Proceedings Acad. Nat. Sci., 1878, p. 330 (15)) gives "Salem, Mass. (C. Cooke)," as a locality for this species, and it undoubtedly occurs regularly in the shallow waters of Cape Cod Bay, although I have never observed specimens north of Cape Cod. It is very common among eel-grass, etc., in Vineyard Sound! and Buzzard's Bay!, 1871, 1875; Fisher's Island Sound!, 1874; Long Island Sound!; south shore of Long Island!, 1870; New Jersey!, 1871; Fort Macon!, North Carolina (Coues, Packard); to the St. Johns River!, Florida (G. Brown Goode).

Pasiphaë tarda Kröyer.

Pasiphaë tarda Kröyer, Naturhistorisk Tidsskrift, II, i, p. 453, 1845; in Gaimard, Voyages en Scandinavie et Laponie, pl. 6, fig. 1 (*Pasiphaea*), 1849.—Lütken, in Manual of the Natural History of Greenland, for the use of the English Arctic Expedition, p. 148, 1875.—G. O. Sars, Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 342, 1877.

Pasiphaea multidentata Esmark, Christiania Videnskabs-Selskabs Forhandlinger for 1865, pp. 259, 316.

Pasiphaë Norvegica M. Sars, Cristiania Videnskabs-Selskabs Forhandling for 1865. pp. 260, 314; Bidrag til Kunskaab om Christianiafjordens Fauna (extract Nyt Magazin for Naturvidenskaberne), p. 42, pls. 4, 5, figs. 65-90, 1868.—G. O. Sars, Untersögelser over Christianiafjordens Dybvandsfauna (extract Nyt Mag. Nat.), p. 21, 1869; Cristiania Videnskabs-Selskabs Forhandling for 1871, p. 262 (19), 1872.

Plate X, figure 1.

Gulf of Maine!, forty-two miles east by south from Cape Ann, about $42^{\circ} 38'$ north latitude, $69^{\circ} 38'$ west longitude, 160 fathoms, soft mud, August 19, 1877,—two specimens, 75 and 53^{mm} in length. Also near the same locality, 140 and 175 fathoms, soft mud, August 27, 1878,—two specimens, one 62^{mm} in length, the other fragmentary.

Greenland (Kröyer). West coast of Norway!, 100 to 525 fathoms (M. and G. O. Sars).

Thysanopoda Norvegica M. Sars.

Forhandling for de Skandinaviske Naturforskeres, 1856, p. 169, 1857; Christiania Videnskabs-Selskabs Forhandling, 1863, p. 2.—Goës, Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 173 (13).—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 15, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Vidensk.-Selsk. Forhandling, 1871, p. 262 (19); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 342, 1877—(?) Norman, Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci., 1868, p. 265, 1869.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, 48 fathoms, soft mud, 1877. Gulf of Maine!, off Massachusetts Bay and off Cape Ann, 1873, 1877 and 1878: 40 to 160 fathoms, mud, sand and mud, mud and stones. Casco Bay!, 1873: in great abundance at the surface on "mackerel ground," during both day and evening; also in dredgings from 64 and 94 fathoms, mud, off Casco Bay. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: in great abundance at the surface, and often brought up in the dredge. Several localities off the coast of Maine!, 95 to 105 fathoms, 1873, 1874. East of St. George's Banks!, 430 fathoms, 1872. Off Cape Sable!, Nova Scotia, 59, 88, and 115 fathoms, sand, gravel and stones, sandy mud, sand and gravel, 1877. Gulf of St. Lawrence!, 210 fathoms, mud, 1873. Greenland (Buchholz). North latitude 75° , east longitude 12° (Goës). West coast of Norway! (G. O. and M. Sars). North Sea (Metzger). (?) Shetland Islands (Norman).

Since this, as well as the next species, is essentially pelagic, swim-

ming in vast numbers at the surface, and doubtless at great depths as well, it is of course somewhat uncertain whether the specimens taken in the dredge really come from the bottom or from some point between that and the surface. It was found in the stomachs of the hake taken in the Bay of Fundy, in 1872, however, which is very good evidence that it lives at the bottom for a part of the time.

In the Bay of Fundy it occurs at the surface in vast swarms, filling the water for miles, and is usually accompanied by schools of mackerel, young pollock, and other fish, and in the autumn by immense flocks of gulls; the fish and smaller gulls appearing to feed almost exclusively upon the *Thysanopoda* at such times. It not infrequently occurs in this way in the harbor of Eastport, Maine, and, with a hand-net, may be caught by the quart even from the wharves. I have observed it only in August, September and October, but Messrs. Merriam and Wilson found it in abundance in April. Professor Verrill observed it, in 1859, swarming in myriads at the "Replings," in the center of the Bay of Fundy. In the Bay of Fundy, the *inermis* was often found associated with this species, but always in very much smaller numbers. The *Norvegica* occurred on "mackerel grounds" in Casco Bay, in the same way as in the Bay of Fundy, though not in such vast abundance.

In life, this species is very beautiful. The whole animal, except the black eyes, is very translucent; the edges of the carapax and the lower edges of the abdominal segments are faintly tinged with red; the upper surface of the carapax, the peduncles of the antennulæ and antennæ, and the cephalothoracic appendages are spotted and banded with deep bright red; the peculiar sense organs at the bases of the first and last pairs of pediform cephalothoracic appendages, and beneath the anterior segments of the abdomen are deep purplish red; the principal ganglia of the nervous system and many of the peripheral nerves are red, or tinged with red. The ganglia of the nervous system are sometimes, if not always, beautifully phosphorescent.

While at Casco Bay in August, 1873, and before I was aware of G. O. Sars' observations on the development of this species (in his zoological voyage of 1865, above referred to), several of the very remarkable larval stages of two species of *Thysanopoda*, most of the larvæ apparently belonging to this species, were found among the collections made at the surface with the towing-net in the evening. The youngest individuals observed belonged to the more common species, and, though apparently by no means the earliest of the free-

swimming stages, show close affinities with the nauplius-stage of the Copepoda, and at once convinced me of the correctness of the conclusions of Claus based on his earlier observations on *Euphausia*. In the earliest stage observed the animal is about $2\frac{1}{2}$ mm long. The compound eyes are already present but are crowded closely together, sessile, and wholly covered above by the front of the carapax. The antennulæ and antennæ are highly developed biramus natatory appendages, the antennæ being still in the simplest naupliar form. The mandibles, both pairs of maxillæ, and the first pair of maxillipeds are developed and show considerable resemblance to the adult form of these appendages. The remaining cephalothoracic appendages have not yet appeared and the corresponding segments of the cephalothorax are only indicated by a closely crowded series of rather obscure annulations. The abdomen, however, is already well-developed and composed of the normal number of segments, and the uropods have even made their appearance in a rudimentary form. This earliest larval stage was unmistakably connected with the adult *Thysanopoda* by several intermediate stages found in company with the younger larvæ.

I should not have alluded to these very imperfect observations in connection with this subject, had not C. Spence Bate,* having apparently overlooked Sars' observations, recently seemed to question the correctness of Claus' conclusions in regard to the larvæ referred by him to *Euphausia*.

I am able to throw no light whatever upon the question as to the manner in which the eggs are discharged or hatched, though it seems most probable to me that the eggs are discharged while the embryo is still immature and are hatched while floating in the water.

Thysanopoda inermis Krøyer.

In Gaimard, Voyages en Scandinavie, en Laponie, au Spitzberg, pl. 7, fig. 2, 1849; Forsøg til en monographisk Fremstilling af Kræbsdyrslægten *Sergestes*, Kongl. Danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afh., iv, pl. 5, fig. 24, 1856 (showing the peculiar sense organs).—Goës, Œfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 174 (14).—Reinhardt, Naturhistoriske Bidrag til en Beskrivelse af Grønland, p. 30, 1857 (extr. from Rink's Grønland).—Lütken, list of the Crustacea of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.

Mentioned, on my authority, as *T. neglecta*?, by Verrill, American Journal of Sci-

* On the Nauplius Stage of Prawns, Annals and Magazine of Natural History, V, ii, p. 79, 1878.

ence, III, vii, p. 411, 1874. Also by Whiteaves, American Journal of Science, III, vii, pp. 213, 214, 1874; and Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 16, [1874?].

Very abundant at the surface in Vineyard Sound!, January 8, 1875, and January 14, 1876 (V. N. Edwards). Massachusetts Bay!, 48 fathoms, mud, 1877. Off the coast of Maine!, 102, 105 and 107 fathoms, mud and gravel, and mud, 1873, 1874. Bay of Fundy!, at the surface, 1864, 1868, 1872; dredged in 40 to 50 fathoms, rocky, 1868; and found in the stomachs of pollock and hake, 1872. Gulf of St. Lawrence!, 50, 70, 210 and 220 fathoms (J. F. Whiteaves). Greenland (Reinhardt, Lütken). Spitzbergen and Finmark (Goës). Lofoten Islands!, Norway (G. O. Sars).

The specimens taken in Vineyard Sound in winter are very slightly smaller and apparently more slender in form than the northern specimens taken in summer and autumn, but seem to differ in no other respect. Specimens from the Bay of Fundy agree perfectly with Kröyer's figures referred to above, and with specimens received directly from Prof. G. O. Sars and labeled by him *T. inermis* Kröyer. Specimens sent several years earlier from the same locality by Prof. Sars to the Smithsonian Institution, as a specimen of the food of *Gadus virens*, and labeled *T. neglecta* Kröyer, appear, however, to be the same species, and do not agree with Kröyer's figures of *T. neglecta*. It was an examination of these specimens which led me to label specimens of our species *T. neglecta*? for Prof. Verrill and Mr. Whiteaves.

In life this species is at once distinguished from the *Norvegica* by its much fainter coloring. It is exceedingly translucent, the sides of the carapax and abdomen, and the bases of the cephalothoracic and abdominal appendages are only slightly tinged with red. The nervous system and the peculiar sense organs, however, are brightly colored as in the *Norvegica*, and these together with the eyes are all that is easily visible as the animal swims gracefully about near the surface of the water.

Erythrops Goëssii G. O. Sars.

Mysis erythropthalma Goës, Crustacea marina Sueciae, Öfversigt af Kongl. Vetenskaps-Akademien's Förhandlingar, 1863, p. 178 (18), 1863.

Nematopus Goëssii G. O. Sars, Beretning om en i Sommeren 1865 foretagen Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt. Mag. Nat.), p. 15, 1866.

Erythrops Goëssii G. O. Sars, Carcinologiske Bidrag til Norges Fauna, Mysider, part

i, p. 24, pl. 1, 1870; Undersøgelser over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 262 (19), 1872.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, August, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; and 48 fathoms, soft mud. Skager Rack, 49 fathoms (Metzger). West coast of Norway!, 30 to 150 fathoms (G. O. Sars). Spitzbergen (Goës).

Meterythrops, gen. nov.

The large and very interesting species, for the reception of which this genus is here proposed, was first made known to me, several years ago, by a few, more or less imperfect, specimens dredged in the Gulf of St. Lawrence, in 1873, by Mr. J. F. Whiteaves, and, in his report on dredging for that year, it is referred to, on my authority, as a species "near to *Erythrops* and *Parerythrops*." The same species was dredged in 1877 by the party of the U. S. Fish Commission on board the "Speedwell," but only imperfect specimens were obtained. The following description and the accompanying figures are based on this meager material. The species combines several characters of the genera *Erythrops* and *Parerythrops* of G. O. Sars, but in general appearance is more like the latter genus. The new genus may be characterized as follows:

The body very short and obese with the posterior cephalothoracic segments almost completely covered above by the large and broad carapax. The eyes well-developed, large, nearly globular, and black after preservation in alcohol. The antennulæ, antennæ, and the oral and cephalothoracic appendages nearly as in *Parerythrops*. The pleopods in the female rudimentary and very nearly as in *Mysis*; in the male, as in *Erythrops*, all the five pairs being well-developed, biramus, and natatory; the inner ramus in the first pair, however, rudimentary and with the terminal part membranaceous, expanded, and nearly naked. The telson long, narrow, sub-triangular, the lateral margins naked, and the apex narrow, truncate, and armed with four spines and two median setæ. The ovigerous pouch composed of four large lamellæ nearly as in *Mysis*.

Meterythrops robusta, sp. nov.

Plate XII, figures 1 and 2.

The carapax as seen from above is of nearly equal breadth to near the posterior extremity, where it is slightly contracted. The frontal

margin projects in an obtuse and rounded angle between the eyes, and, beneath the eye each side, the lateral margin projects into an acute and spiniform angle, just above which there is a deep sinus in the margin for the reception of the base of the antenna. The transverse sulcus is well-marked, strongly arcuate, and terminates each side just above the antero-lateral spine. The lateral margin is bent strongly upward in an obtuse angle at a point about a third of its length from the anterior margin. The posterior margin is only slightly emarginate. The eyes are very large, their greater diameter being more than a third of the breadth of the carapax, remote from each other, and attached by very slender bases; they are very nearly globular, though slightly flattened above, and the black, faceted area, occupying the greater portion of the surface, terminates in a regular and slightly arcuate line above. The peduncles of the antennulæ are only a little longer than the eyes, and the distal segment in each is as long as the two proximal, of which the second one is very short, not half as long as the first and much shorter upon the outer than upon the inner side. The flagella are stout and the outer longer than inner, as usual. In the adult male the segments of the peduncle are stouter than in the female, the basal and terminal segments each being as broad as long, and the distal segment terminates, beneath the base of the inner flagellum, in an obtuse, conical, and densely hirsute or ciliated process similar to that in the males of *Erythrops* and *Parerythrops*. The squamiform appendage of antenna (Plate XII, figure 2), is only about three times as long as broad, the greatest breadth being toward the distal extremity; the outer margin is nearly straight from near the base and terminates in a very large dentiform spine. From the base of this spine the anterior margin is very oblique, only slightly arcuate, scarcely longer than the breadth of the scale itself, and terminates in an oval tip which is about a third of the width of the scale in front of the tip of the lateral spine. The inner and terminal margins together are furnished with nearly fifty setæ, of which about a third are on the terminal margin. The peduncle of the antennula does not reach to the middle of the squamiform appendage, and the three distal segments are very short, the ultimate and antepenultimate each being about as broad as long and the two nearly equal in length, while the penultimate is shorter than either. The flagellum is stout and probably nearly as long as the rest of the animal, though, in all the specimens examined, the terminal portion is wanting.

The mandibles agree very closely, except in some of the details of

the armament of the coronal extremities, with the mandibles of *Parerythrobs obesa*. In each mandible the inferior angle of the crown is separated by a broad space from the superior, or molar, angle. The inferior edges and the molar processes in both mandibles are almost exactly as in *Parerythrobs obesa*: the inferior edge itself is much alike in the two mandibles, being composed of about four irregular, obtuse teeth, but the dentiform process just within the edge differs in the two mandibles; in the right it is more slender and prominent than in the left, and enlarges at the extremity, which is armed with several rather slender teeth; while in the left the process is shorter, stouter, and terminates in shorter teeth. The space between the armament of the inferior edge and the molar process is, in each mandible, furnished with twelve to fourteen setiform teeth which are very different in the two mandibles: in the left they are slender, crowded closely together, and armed with minute, spiniform teeth; while in the right they occupy a much larger space, are thin, acutely triangular, and wholly destitute of secondary spines or dentations, except, possibly, one or two exceedingly minute spinules at the bases of a few of them. The mandibular palpi have almost precisely the same form, proportions, and armament of spines and setæ as in *Parerythrobs obesa*.

The first maxillæ are throughout exactly as in *Parerythrobs obesa*. The second, also, have very nearly the same form and proportions as in that species; the outer lobe, or scaphognath, however, differs in being broadly oval, margined with twenty-five to thirty setæ, and in having the anterior extremity rounded and tipped with four setæ, two of which are very distinctly on the inner margin inside the tip, while in *Parerythrobs obesa* the scaphognath is triangular anteriorly, is margined with only fifteen to eighteen setæ, none of which are really on the inner margin, although there are two at the narrow tip; the three lobes of the protognath and the two segments of the palpus (endognath) are exactly as in *Parerythrobs obesa*, except that they are furnished with a few more setæ.

The endognath in the maxillipeds is almost exactly like this part of the same appendage in *Parerythrobs obesa*. The exognath differs in being very slightly larger proportionally and in having thirteen or fourteen segments in the flagelliform portion. The endognath in the first gnathopods (second maxillipeds) does not differ from the same part in *Parerythrobs obesa*, except that it is armed with a somewhat greater number of setæ and spines, particularly on the distal part of the outer margin of the longest segment (merus). The exognath is

exactly like that of the succeeding appendages: the base is very broad and muscular in both sexes, though somewhat broader in the males, and the outer distal angle projects in a distinct and rather acute tooth; and the flagelliform portion is composed of fifteen or sixteen segments.

The second gnathopods (third maxillipeds) and the five pairs of pereopods (cephalothoracic legs) are all alike in size and armament, the second gnathopods being apparently fully as long as the succeeding appendages. The length of the endognath in each is about equal to the length of the carapax, and the four distal segments (forming the "tarsus") are almost exactly equal in length to the three (basis, ischium and merus)* which next precede them, the relative proportions of the different segments and their ratio to the rest of the animal being in fact almost exactly as in the pereopods of *Parerythrops obesa*. The endognaths of the second gnathopods and of the five pairs of pereopods are rather larger proportionally than in *Parerythrops obesa*, and, as in the exognath of the first gnathopods, the outer distal angle of the basal portion projects in an angular

* The distal portion of the pediform cephalothoracic appendages, which is normally composed of three segments, the carpus, propodus and dactylus, often contains in the Mysidæ more than the normal number of segments, and is well called the tarsus by G. O. Sars, in some of his recent papers. The additional segments appear to result from the segmentation of the carpal segment only, and I so regard them in this and the following descriptions. In the Caridea the carpal segments in some of the cephalothoracic legs are often divided or even multiarticulate, and that this is the normal segment which gives rise to the more or less numerous supplementary segments in the tarsus of the Mysidæ, is, I think, well shown in the second pair of gnathopods in the different genera of the family. In *Heteromysis* this portion of the tarsus is composed of the normal number of segments, although the carpus is very large and the propodus unusually short; in *Parerythrops obesa*, in the new species here described, and in the species of *Pseudomma*, the tarsus is composed of four segments but the division between the two first segments is very imperfect, admits of very little if any motion, and apparently has no special muscles attached near it, while the more distal articulations are of the ordinary character. In the new species of *Pseudomma* described beyond, this division of the carpus is so very incomplete that it is usually exceedingly difficult to discover it. It is evident that the four tarsal segments in the succeeding pairs of cephalothoracic appendages in *Parerythrops*, *Meterythrops* and *Pseudomma*, correspond to the four tarsal segments in the second gnathopods; and, in the absence of any facts to the contrary, it would seem proper to conclude that the ultimate and penultimate segments of the more or less numerous segmented tarsi of all the pediform cephalothoracic appendages of Mysidæ in general are homologous with the dactylus and propodus, and that the additional segments have all resulted from segmentation of the carpus.

tooth and the flagelliform portion is composed of fifteen or sixteen segments.

The abdomen is much narrower than the carapax and tapers only slightly; the first four segments are subequal in length, the fifth a little shorter, and the sixth a fourth longer than the fifth. The telson (Plate XII, figure 2 *c*) is as long as the sixth segment, narrow, triangular and twice as long as the width at base; the lateral margins are wholly unarmed and are suddenly expanded laterally near the base, but are nearly straight from this expansion to the tip. In the dorsal surface there is a deep median sulcus extending the whole length, and from this the surface slopes down each side to the lateral margin which is strongly upturned throughout. The extremity (figure 2 *d*) is very narrow, truncated in a straight line and armed with a median pair of slender spines of which the outer one is much shorter and more slender than the inner, which is itself about two-thirds as long as the space between the bases of the outer spines.

The inner lamella of the uropods (Plate XII, figure 2 *a*) reaches only a little beyond the tip of the telson, is expanded at the base for the reception of the acoustic apparatus, but beyond this is narrow and linear in outline; both margins are furnished with long ciliated setæ which are nearly twice as numerous on the inner as on the outer edge, and, in addition, the inner edge is armed beneath with a small spine at the base of each seta. The outer lamella is nearly a third longer than the inner, fully six times as long as broad, the greatest breadth being near the middle of the length, and both margins are regularly, though slightly, curved inward and each furnished with about equally numerous setæ.

The bases of all the pleopods in the male are rectangular in outline, and are very stout and muscular. The inner rudimentary ramus in the first pair of pleopods (Plate XII, figure 1 *a*) is soft, membranaceous, and about a third as long as the outer; the terminal portion is slightly swollen, and rounded at the extremity; and the lamellar appendage projecting outward from near the base, and corresponding to that upon the same ramus of the succeeding pleopods, has three or four hairs at the truncated tip and about the same number of shorter ones on the upper edge. The outer ramus in the first pair is, like the same ramus in the succeeding pairs, slender, much longer than the base, and composed of about fourteen segments. The inner rami of the second to the fifth pair of pleopods are similar to the outer, except that they all have the lamellar appendage near the base, like that upon the rudimentary ramus of the first pair, and usually

have one or more less segments than the corresponding outer branch. The number of segments in both the inner and outer rami varies somewhat, however: in the fully adult male, 28.5^{mm} in length, there are fourteen segments in each of the outer rami of the first pair; twelve in the outer and thirteen in the inner of the second and third pairs; eleven in the inner and twelve in the outer of the fourth pair; and only eight in the inner and twelve in the outer of the fifth pair. In a young male, only 13.5^{mm} long, there appear to be one or two less segments in each of the natatory rami of all the pleopods, although the rudimentary rami in the first pair, and the lamellar appendage of the inner ramus in the succeeding pairs, are well-developed.

The rudimentary pleopods of the female do not differ essentially from same appendages in the allied genera. They resemble more closely, however, the pleopods of the females of the species of *Mysis* than of *Parerythrops obesa*, the setæ with which they are armed being fewer in number and much longer than in that species.

Massachusetts Bay!, off Salem, 33 fathoms, sand and mud, August 4, 1877,—young male and female; also 33 fathoms, soft mud, August 13,—one young male. Off Bay of Chaleurs, Gulf of St. Lawrence!, 50 and 70 fathoms, 1873,—adult male and two females, one, 16.5^{mm} long, the other, 14^{mm}.

Pseudomma roseum G. O. Sars.

Pseudomma roseum G. O. Sars, Nye Dybvandscrustaceer fra Lofoten, Christiania Videnskabs-Selskabs Forhandling, 1869, p. 154 (10); Carcinologiske Bidrag til Norges Fauna, Mysider, part i, p. 54, pl. 4, 1870; Undersøgelser over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 263 (20); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.—Whiteaves, Report on further deep-sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 16. [1874?].

Near Jeffrey's Bank!, Gulf of Maine, 105 fathoms, brown mud, September, 1873,—one specimen. Gulf of St. Lawrence!, 1873, 28 miles east-northeast of Cape Gaspé, 110 fathoms; and 25 miles east by north of Cape Gaspé, 210 fathoms,—several specimens at each locality. West coast of Norway, at the Lofoten Islands!, 200 to 300 fathoms; and Hardanger Fiord, 100 fathoms, and between 400 and 500 fathoms (G. O. Sars). Off Mandel, southern Norway, 220 fathoms (Metzger).

Pseudomma truncatum, sp. nov.

Plate XII, figures 3, 4.

This species is nearly allied to *P. roseum* and resembles it very closely in form and general appearance. The new species has proportionally shorter pereopods, however, and is readily distinguished by the terminal portion of the antennal scale and by the form of the telson.

The form and proportions of the carapax and abdomen are exactly as in *P. roseum*. The ophthalmic segment (Plate XII, figure 3 a) is a little broader in front than in *P. roseum*, the dentated portions of the margin are slightly more lateral and the dentations not quite as well-marked as in that species, and there seems to be less difference in the sexes in the form of the anterior margin. The antennulæ are as in *P. roseum*, except that the flagella are apparently a little shorter. The relative proportions of the segments of the peduncles of the antennæ are the same as in *P. roseum*. The squamiform appendage (figure 3) of the antenna is about three and a half times as long as broad; the outer margin is about five-sixths of the entire length and terminates in a stout tooth, as in the allied species; the inner margin is regularly arcuate and furnished with in the neighborhood of thirty setæ; the terminal portion, in front of the base of the terminal spine of the outer margin, is regularly and rather broadly ovate and not longer than the breadth of the scale; the setæ of the outer portion of the terminal margin, from the base of the lateral spine to near the tip, are nearly or quite twice as remote from each other as on the corresponding part of the inner margin, there being only three or four setæ until near the tip where there are three to five more, closely crowded together as on the inner margin. In *P. roseum* the terminal portion of the antennal scale is proportionally longer than in *P. truncatum*, being about one and a half times the breadth of the scale in advance of the base of the lateral spine, and the setæ on the outer portion of the terminal margin are as closely crowded as on the inner margin and twice or three times as numerous as in *P. truncatum*.

The oral appendages are as in *P. roseum*. The second gnathopods (third maxillipeds) have the same structure and proportions of the distal and proximal segments of the endopod, and the same number of segments in the flagelliform portion of the epipodal branches, as in *P. roseum*; but the three longest segments (the meral and the divided carpal), though varying considerably in different individuals of the same sex and size, and even on the different sides of the same

individual, are proportionally shorter than in that species, and consequently the entire endopod is correspondingly shorter, being only very slightly longer than the carapax. The articulation between the two divisions of the carpus is imperfect, very indistinct, and in some specimens is made out only with the greatest difficulty, even when the appendages in question have been specially mounted for the purpose; in *P. roseum*, however, this articulation is perfectly distinct as it is in the five pairs of pereopods in both species.

The five pairs of pereopods have precisely the same form and structure as in *P. roseum*, and, as in that species, increase successively in length posteriorly, but differ in the lengths of the three longest segments in the same way as the second gnathopods. In *P. truncatum* the length of the pereopods varies considerably in different specimens of the same sex and age, and even on the different sides of the same specimen, but the first pereopods are about a third as long as the entire body of the animal and the posterior pair are fully one-half as long, or about as long as the second pair in *P. roseum*.

The proportions of the segments of the abdomen are almost exactly as in *P. roseum*: the five anterior segments are sub-equal in length, though increasing very slightly posteriorly, and the fifth is about as broad as long and the first about a third broader than long; the sixth segment is about once and a half as long as the fifth and about two-fifths as long as broad. The telson (figures 3 *b* and 4) is considerably shorter than the sixth segment, and, at base, about three-fourths as broad as long, sub-triangular, and truncated at the tip, which is about a third as broad as the base; the lateral margins are armed for a little more than the distal half of the length, with about seven small spines which are rather more crowded proximally; the tip is truncated and armed with two pairs of strong spines several times as long as those upon the lateral margins, and a median pair of slender plumose setæ, which are slightly longer in the male than in the female. In *P. roseum* the telson is as long as the sixth segment of the abdomen, the tip is rounded, and the lateral and terminal spines form a single series. The lamellæ of the uropods are somewhat shorter and broader in proportion to the length, but absolutely of about the same breadth as in *P. roseum*.

Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): off the Bay of Chaleurs, 50 and 70 fathoms, August 4,—between twenty and thirty specimens; and also between Bradelle Bank and Miscou Island, 45 fathoms, mud and stones, August 7,—one male.

Heteromysis.

Heteromysis Smith, Invertebrate animals of Vineyard Sound, in Report of U. S. Commissioner of Fish and Fisheries, part i, p. 553 (259), 1874.

Chiromysis G. O. Sars, Middelhavets Mysider, Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 56 (48), pls. 19, 20, 1877.

Professor Sars' *Chiromysis microps*, described from females only, is unquestionably congeneric and specifically very closely allied to my species mentioned below. As pointed out both by Professor Sars and myself, the most conspicuous characteristic of the genus is in the structure of the endognath of the second pair of gnathopods (third maxillipeds, or, according to Sars, first legs), which are very unlike the pereopods, being longer, very much stouter, with the terminal, or "tarsal," portion composed of the three normal segments, of which the proximal (carpus) is about as large as the preceding segment (merus), the two distal segments very short, the propodus being as broad as long and the dactylus forming a terminal claw; while the five pairs of pereopods are as in the genus *Mysis*. The male affords additional generic characters, in having all the pleopods like those of the female (in which they are as in *Mysis*), and in having no prominently projecting sexual appendage upon the peduncles of the antennulæ, but in its place only a slightly raised and nearly transverse elevation, densely clothed with hairs.

Heteromysis formosa Smith, loc. cit.

New Haven!, Connecticut. Tide-pool at Thimble Islands!, near New Haven (A. E. Verrill, 1874). Gardener's! and Peconic! Bays, 1874. Vineyard Sound! and Buzzard's Bay!, surface to 10 fathoms in depth, 1871, 1875. "Among weeds, Haste Island," Salem!, Massachusetts (J. H. Emerton, 1878).

Although very closely allied to the Mediterranean species, the *H. formosa* is readily distinguishable by the following characters. The stout carpal segment in the second pair of gnathopods, in the female, is armed along the distal half of the inner margin with six to eight slender spines in place of the four in *H. microps*, and there are in addition twelve to fifteen setæ longer than the spines and extending nearly the whole length of the margin. In the male, however, this segment is a little more slender and has fewer spines and setæ than in the female. The short propodal segment, as seen in a side view, is nearly square, its distal margin being parallel with the proximal and having no angular prominence on the inner side as in *H. microps*. The inner lamellæ of the uropods are nearly as long as the outer,

taper distally more than in *H. microps*, and the inner margin in each is armed with a series of twelve to eighteen slender spines, extending almost to the tip, in addition to the long setæ, while in *H. microps* there is only a single spine near the base. The telson differs from that of *H. microps* in having the lateral margins incurved at the tips and each armed with eleven to sixteen spines, of which nearly all are on the distal half of the margin and all placed at nearly equal distances from each other, none of the proximal ones being scattered from the series as in *H. microps*; the terminal spine each side has no small spine at its base but stands entirely alone; the sinus of the terminal margin is broad and broadly rounded at the proximal end, its lateral margins are nearly straight instead of convex in outline, and there are only fourteen to twenty spines on the entire margin.

All the specimens I have examined have been taken in August and September and a large proportion of the individuals are females carrying eggs or young. The species was never found in abundance except hidden away inside dead bivalve shells, usually *Macrass*, dredged in 5 to 10 fathoms. As many as twenty were sometimes found in a single shell. The males and young were occasionally taken at the surface in the evening in Vineyard Sound.

Mysis mixta Liljeborg.

Mysis mixta Liljeborg, Hafs-Crustaceer vid Kullaberg, Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, pp. 3, 6.—Goës, Crustacea decapoda Sueciae, Öfversigt af Vet. Akad. Förhandl., 1863, 175 (15).—G. O. Sars, Undersøgelser over Christianiafjordens Dybvandsfauna, 35, 1869 (extr. Nyt Magazin Naturvidenskaberno); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.

?*Mysis latilans* Krøyer, Et Bidrag til Kundskab om Krebsdyrfamilien Mysidae, Naturhistorisk Tidsskrift, III, i, p. 30, pl. i, fig. 4, 1861.

Massachusetts Bay!, off Salem, 1877: 20 fathoms, gravel, August 6,—more than 200 specimens: abundant, also in August, in 22 fathoms, gravel; 33 fathoms, sand and mud; 33 fathoms, soft mud; and 35 fathoms, mud and clay nodules: common in 48 fathoms, mud, August 13. Gulf of Maine!, off Cape Ann, 1877: common at 90 fathoms, mud, August 14, and at 50 fathoms, mud, gravel and rocks, October 17. Off Cape Ann!, 54 fathoms, gravel and stones, 1873. Also abundant, in 30 to 50 fathoms, muddy and gravelly bottoms, at various localities off Cape Ann!, 1878. Casco Bay!, August, 1873: six miles southeast from Seguin Island, 35 fathoms, mud; about seventeen miles off Cape Elizabeth, 64 fathoms, mud; and about

twenty miles off, 68 fathoms, mud. Bay of Fundy, 1864,—one specimen. ? Greenland (Kröyer,—*M. latitans*). Iceland (G. O. Sars). Finmark (Goës), Lofoten Islands! and Christiania Fiord (G. O. Sars). Baltic (Liljeborg, et al.).

All the American specimens examined were taken between August 4 and October 17; most of them are young, between 12 and 20^{mm} long, a few, however, are females, from 20 to 25^{mm} long, with nearly fully developed ovigerous lamellæ, but none of them carrying eggs. This seems to show that the breeding season is during the winter, and it apparently indicates that the species is an annual like *M. mixta*.

Mysis stenolepis Smith.

? *Mysis spinulosus* Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 333, 1841 (not of Leach).

Mysis stenolepis Smith, Report on the Invertebrate Animals of Vineyard Sound, Report, U. S. Commissioner of Fish and Fisheries, part i, p. 551 (257), pl. 3, fig. 12, 1874.

New Haven!, Connecticut, among eel-grass. Noank!, Connecticut, among eel-grass, etc., 1874. Vineyard Sound! and Buzzard's Bay!, among eel-grass, and also dredged in a few fathoms among algæ, 1871, 1875. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Casco Bay!, 1873: Portland Harbor, among eel-grass; Quohog Bay, among eel-grass; between Overset Island and Peak's Island, 18 fathoms, rocks and sponges; and off Ram Island, 18 fathoms, mud. Halifax!, Nova Scotia, 1877: Outer Harbor, 16 to 21 fathoms, fine sand, stones, and red algæ; also, 18 fathoms, mud and fine sand.

This species, although very closely allied to *M. mixta* is certainly distinct. The antennal scales in *stenolepis* are much longer and proportionally narrower toward the base than in the allied species (in the full-grown female the greatest breadth being contained in the length about twelve times in *stenolepis*, and scarcely nine times in *mixta*), and nearly the whole outer margin of the scale is concave in outline in *stenolepis*, while in *mixta* it is nearly straight, or even slightly convex toward the base, where the concavity is usually greatest in *stenolepis*. The two distal segments of the antennular peduncle are nearly equal in length in *stenolepis*, the penultimate being only very slightly the longer; while in *mixta* the penultimate is fully a third longer than the ultimate and absolutely longer than in *stenolepis* (the length of the penultimate segment being contained in the

length of the antennal scale little over six times in *mixta*, but about ten times in *stenolepis*.

The sinus of the posterior margin of the telson is much broader and deeper in *mixta* than in *stenolepis*, but the edges of the sinus are armed with fully as many spines in *stenolepis*, so that they are much more closely crowded. The spines of the lateral margins of the telson are fewer and rather larger in *stenolepis* (there are usually twenty-four or twenty-five spines each side in the adult *stenolepis*, and over thirty in *mixta*) and do not extend to so near the tip, the most posterior spines in *stenolepis* arising very little if at all back of the bottom of the sinus of the posterior margin, while in *mixta* there are at least three or four spines arising back of the bottom of the sinus. A part of this last difference is due to the greater depth of the sinus in *mixta*, but the terminal portion of the margin back of the spines is absolutely fully twice as long in *stenolepis* as in *mixta*.

The coloration, even in ordinary alcoholic specimens, affords the readiest means for distinguishing the two species, however. In *mixta* there is a small arborescent spot of black pigment upon the upper side of the last cephalothoracic segment, upon each of the segments of the abdomen except the sixth, one each side at the base of the telson, and beneath upon the ovigerous lamellæ and upon each of the first five segments of the abdomen; there are similar but much smaller spots upon the bases of the antennulæ and antennæ and usually two minute ones on the distal half of the antennal scales; but with the exception of these pigment spots and the eyes, the entire animal is opaque white, turning to grayish white in alcohol. In specimens which have been preserved in alcohol for a very long time, the pigment spots often become obscure or wholly obliterated. In *stenolepis*, on the other hand, the peduncles and inner flagella of the antennulæ, the scales of the antennæ, the dorsal sides of the eye-peduncles, the dorsal surface of the whole abdomen, the telson, and both lamellæ of the uropods are covered with widely and thickly branching ramifications of numerous large pigment spots. The color is particularly conspicuous upon the peduncles and inner flagella of the antennulæ and upon the antennal scales, all which parts of the animal appear very dark or often almost black. There is considerable variation in the amount of pigment in different individuals, but in all the specimens examined it is invariably present upon all the parts above mentioned, and is still very conspicuous in specimens which have been preserved in alcohol for many years.

This difference in the coloration of the two species is undoubtedly

a result of the difference in their habitats, the *stenolepis* being confined to shallow water where the bottom is overgrown with eel-grass or algæ, abounding particularly among eel-grass during the summer and autumn; while the *mixta* is apparently confined to deeper, and, at least in summer, very much colder, water, ranging from twenty to a hundred or more fathoms, where there is no eel-grass and seldom, if ever, algæ.

The *stenolepis* is an annual species; the young appear in early summer, come to maturity early in the winter, produce young from mid-winter to spring, and all the mature individuals disappear before the second summer, the males disappearing long before the females. The following tabulation of the results of an examination of several collections made at different seasons of the year, illustrates this fact.

Locality.	Date.	No. of specimens, age and sex.	Length in mm.	Remarks.
Vineyard Sd.,	July 4	10 +; young.	10 to 15	Among eel-grass.
Casco Bay,	14	50 + "	10 to 18	" "
"	16	100 + "	12 to 18	" "
"	Aug. 19	200 + "	15 to 18	" "
Halifax,	25	2 "	14	16 fathoms, algæ.
Casco Bay,	27	20 + "	15 to 20	18 fathoms, rocks and sponges.
Vineyard Sd.,	Sept. 2	3 "	17	Taken at surface.
Halifax,	6	9 "	14 to 16	16 fathoms, sand and algæ.
"	15	8 "	14 to 16	18 fathoms, mud and sand.
Vineyard Sd.,	Dec. 13	80; females.	25 to 30	Ovigerous sacs well developed and many filled with eggs.
"		16; males.	21 to 24	
"	Jan. —	100 +; females.	24 to 28	Ovigerous sacs well developed and nearly all filled with eggs.
"		1; male.	21.5	
"	April 3	50 +; all females.	25 to 29	All with fully developed young or empty ovigerous sacs.
"	24	100 +; "	25 to 30	Mostly with empty ovigerous sacs.
"	May 12	100 +; "	25 to 29	All, or very nearly all, with empty ovigerous sacs.

Mysis oculata Krøyer ex O. Fabricius.

Mysis spinulosus Packard, Canadian Naturalist and Geologist, vol. viii, p. 419, 1863.

Mysis oculata Packard, Memoirs Boston Society Nat. Hist., vol. i, p. 301, 1867.

Labrador!, "abundant along the whole coast" (Packard). Grinnell Land, as far north as latitude 79° 29' (Miers). Greenland (Krøyer, Stimpson, et al.). Iceland (G. O. Sars). Buchholz and Miers each include Spitzbergen among the habitats of this species. The very closely allied form, *M. relicta* Lovén, by Professor G. O. Sars regarded as only a variety *M. oculata*, occurs in the Gulf of Bothnia (G. O. Sars), in the fresh-water lakes of southern Scandinavia! (Lovén, G. O. Sars), and in Lakes Michigan! and Superior!.

Stimpson (Marine Invertebrata of Grand Manan, p. 58), reports this species (with an?) as "very abundant in the waters at the mouth of the Bay of Fundy, swimming near the surface in swarms." I have never seen specimens from the Bay of Fundy, and, during several seasons spent there, I have never observed any species of *Mysis* swimming at the surface, as described by Stimpson. *Thysanopoda Norvegica* and *inermis*, however, were found in vast numbers in precisely the same way as the *Mysis* is said by Stimpson to occur, and it is possible that Stimpson, without making a special examination, mistook the vast swarms of *Thysanopoda* for *Mysis oculatu*.

Mysis Americana Smith.

Mysis Americana Smith, Report on the Invertebrate Animals of Vineyard Sound. Report U. S. Commissioner of Fish and Fisheries, part i, p. 552 (258), 1874.

Great Egg Harbor!, New Jersey, 1871,—in pools on salt-marshes, and in great abundance in the stomachs of the ocellated flounder (*Chænopsetta ocellaris*), the spotted flounder (*Lophosetta maculata*), and the shad. Stomach of shad!, Great South Bay, Long Island, May 21, 1875. New Haven!, Connecticut,—abundant among seaweed, etc., May, 1873 (A. E. Verrill and D. C. Eaton); and in great abundance among hydroids, etc., under wharves, May, 1875 (S. F. Clark); also dredged in 4 to 5 fathoms. Vineyard Sound!, young occasionally taken at the surface in summer, 1871, 1875; also in the dredge from 25 fathoms, but probably taken on the way up; and common in the stomachs of shad, mackerel, and sea-herring. Portland Harbor!, Casco Bay, taken at the surface and dredged in 3 fathoms, mud, 1873.

This species breeds during the spring and summer, and very likely during the larger part of the year, since the young and old are often found together in spring and summer. The males are nearly or quite as large as the females. Females carrying eggs or young vary, in a large lot from New Haven, from 10 to 14^{mm} in length, and many of the males in the same lot are of the latter length. One egg-carrying female from Casco Bay is only 9.5^{mm} long.

The *Americana* is closely allied to *M. vulgaris* of Europe, but is very readily distinguished by the telson, the lateral margins of which are armed with spines of nearly uniform size in *vulgaris*, while in *Americana* they are armed with stout spines alternating with intervals of several smaller ones. There are numerous other, but less conspicuous differences.

CUMACEA.

The following account of the Cumacea is even more imperfect than the enumeration of the species of the groups treated above. No reference is made to a few small species, which are represented in the collections examined by young or imperfect specimens only. Several of the species were first very kindly determined for me several years ago by Professor G. O. Sars.

Diastylis Rathkii Bate.

Cuma Rathkii Krøyer, Naturhistorisk Tidsskrift, iii, pp. 513, 531, pls. 5, 6, figs. 17–30, 1841 (♀); *ibid.*, II, ii, pp. 145, 207, pl. 1, figs. 4 and 6, 1846: in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 1, 1849.—Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.—Möbius, Die wirbellosen Thiere der Ostsee, Exped. 1871 auf Pommerania, p. 122, 1873.

Cuma angulata Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 156, 206, pl. 2, fig. 1, 1846; in Gaimard, *op. cit.*, pl. 5, fig. 2, 1849 (♂).

Diastylis Rathkii Bate, Annals and Magazine Nat. Hist., II, xvii, p. 451 (3), pl. 13, figs. 1–21, 1856.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlinger, 1864, p. 160; Om Cumaceer fra de store dybder i Nordishavet, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 7, pl. 3, figs. 8–9, 1873; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1875.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.

Akuma Goodsiri Packard, Memoirs Boston Soc. Nat. Hist., i, p. 301, 1867. (Not of Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, ii, p. 403, pl. 34, fig. 2, 1855; though it is very probably the species mentioned by Bell as perhaps a form of his species and partially figured on the same plate, figure 3, with which figure Packard identified his specimens.)

Off Halifax!, Nova Scotia, 1877: 42 fathoms, fine sand,—five males, six females; 52 fathoms, fine sandy mud,—one male, seven females; 57 fathoms, gravel and stones,—one specimen. Also just off Chebucto Head!, Halifax, 1872, 20 fathoms, soft mud and fine sand,—young only. Gulf of St. Lawrence!, 1871, 1872, 1873 (Whiteaves). Labrador! (Packard). Greenland (Krøyer, Norman). North latitude 81°, east longitude 1°, 450 fathoms (G. O. Sars). British Isles! (Norman). Norway! (G. O. Sars). Baltic! (Möbius).

In 1873 I sent some of the specimens collected on the coast of Labrador by Prof. Packard, to Prof. G. O. Sars and he wrote me that they belonged to a new species, but I am unable to find any constant differences which will distinguish the specimens which still remain from Prof. Packard's collection from European specimens of *D. Rathkii*. Most of the specimens from Labrador have the sides of

the anterior part of the carapax a little smoother than usual in the species, but the difference is very slight and apparently not constant, and it may be due to the bad state of preservation of the specimens. The specimens from off Halifax, and most of those from the Gulf of St. Lawrence, agree perfectly with the European specimens which I have examined.

Diastylis politus, sp. nov.

Adult female.—The cephalothorax is elongated and, including the lateral spiniform processes of the last segment, nearly half as long as the length from the tip of the rostrum to the tip of the telson, pretty regularly oval in outline as seen from above, and regularly and strongly convex dorsally as seen from the side. The carapax is rather more than half as long as the whole cephalothorax, about three-fourths as broad as long, and very much longer than high. The posterior edge is regularly arcuate and has an elevated margin which extends round the broadly sinuous inferior edge to an angular prominence below the base of the rostrum as in *D. sculptus*, and the anterior portion of the inferior edge is minutely dentate as in that species. The rostrum is short, nearly horizontal, and rather obtuse as seen from above.

The surface of the carapax is naked and nearly smooth, except that the anterior portion is areolated somewhat after the manner of *D. sculptus*, but the areolations are fewer and less deeply excavated, and they do not extend to the postero-lateral portions of the carapax as in that species. As seen from above, there are two minutely dentate transverse crests, as in *D. sculptus*, upon the semi-circular median lobe, and the posterior of these extends across the lobe and connects with a perpendicular crest which extends in a nearly straight line to the lateral margin just back of the angular prominence below the base of the rostrum. In front of this vertical crest each side there is a short and prominent crest, slightly curved and nearly parallel with the inferior margin, but which does not reach the inferior margin of the rostrum and fades out posteriorly before it reaches the vertical crest. Just back of the first vertical crest, is a second which curves sharply forward and connects with the first below, but which is straight and slightly diverges from the first above. At the suture round the median lobe this second crest is connected with the first by a short ridge, so as to leave a nearly square area, as in *D. sculptus*, each side of the median line, as seen from above, and just back of the posterior transverse crest of the median lobe. Just back of the upper

part of this second vertical crest, there is each side a similar but less conspicuous crest parallel with the second, but extending only a short distance from the median line. The whole postero-lateral region of the carapax is unsculptured and nearly smooth.

Of the five free segments of the cephalothorax, the first and second are nearly as in *D. sculptus*, except that the lateral expansion of the second segment, just above the attachment of the leg each side, projects more abruptly and further anteriorly, so as to overlap the first segment and nearly reach the margin of the carapax. The third and fourth segments together are a little broader than the first and second, but the third is only about half as wide as the fourth and is closely consolidated with it above. The lateral portions of these segments are very much as in *D. sculpta*, except that the third segment projects slightly forward, as well as backward, above the base of the leg each side. The fifth segment projects back each side and terminates in a slender spiniform process over the base of each leg as in *D. Rathkii*. The three last segments in fact resemble the corresponding parts of *D. Rathkii* much more nearly than those of *D. sculptus*.

The antennæ and the three pairs of maxillipeds are almost exactly as in *D. sculptus*. The first cephalothoracic legs are a little shorter than in that species, the distal end of the propodus only just about reaching to the tip of rostrum, but the relative lengths of the segments themselves are about the same. The second legs are of about the same length relatively as in *D. sculptus*, but the proportions of the segments are different, the carpus being conspicuously long and slender. The stout curved basis is about as long as the merus and carpus combined, and is margined below with ciliated setæ. The carpus is very slender, longer than the combined lengths of the merus, propodus and dactylus, and naked except a few short hairs on the outer side and a group of slender setæ at the distal extremity. The propodus and dactylus are correspondingly slender, the dactylus slightly the longer, and the combined length of the two segments is only slightly more than half the length of the carpus. The third, fourth and fifth legs are nearly as in *D. sculptus*, but the carpal segments are only about three-fourths as long as the meral.

The abdomen, to the tip of the telson, is only slightly longer than the cephalothorax, and all the segments, except the telson, have very nearly the same form and proportions as in *D. sculptus*. The telson is about as long as the fifth segment, broad at the base and abruptly narrowed to a slender terminal portion scarcely longer than the stout basal part, and the slender portion is armed with only six to nine

pairs of spines. The basal portions of the uropods are about a fourth longer than the telson, slender, and each armed along the distal three-fourths of the inner side with a series of ten to twelve small spines which become more scattered proximally and never extend to the base. The inner ramus is about two-thirds as long as the base, composed of two segments, slender, tapers to a long and slender spiniform tip, and is armed along the inner edge with eight to ten spines, of which four are usually upon the basal segment, and one, or sometimes two, upon the outer edge. The outer ramus is somewhat longer than the inner, slender, tipped with two long setiform spines, and armed upon the outer edge with six to ten very slender spines, but with only a single spine upon the inner margin near the tip.

The *adult male* differs from the female in being more slender, in having the cephalothorax much more compressed vertically, and, as usual in the genus, in the structure of the antennæ, the anterior abdominal appendages, etc. The carapax is much more depressed than in the female, the height being less than half the length, and much broader and more obtuse anteriorly as seen from above. The surface is more conspicuously punctated than in the female, but the anterior portion is areolated in the same manner, except that there is in addition a prominent longitudinal carina-like crest each side, extending in a straight line from the inferior margin just in front of the postero-lateral angle to the sharp curve at the lower end of the second vertical crest. The margin of the carapax below this is incurved much more abruptly than in the female, so that the sides of the carapax are angulated each side at the widest part,—almost exactly as in the male of *D. Rathkii*. The telson is much longer than in the female, has the usual sharp dorsal angle between the basal and terminal portion, and is armed with eight to ten pairs of slender spines which are longer than in the female. The bases of the uropods are armed with ten to sixteen spines, and the inner edge of the inner ramus with twenty-four to thirty spines, of which ten to twelve are on the basal segment.

This is a much larger species than *D. sculptus*, the length of the adult female, from tip of rostrum to extremity of telson, being about 12^{mm}; of adult male, about 14^{mm}.

In life the males, at least, are semi-translucent, whitish, with the ophthalmic lobe pink.

Vineyard Sound!, July 20, 1875,—one young male taken at the surface. Adult males were taken at the surface at the same locality, by Mr. Vinal N. Edwards, December 8, 1875, March 22, 1876, April,

1877; adult males and a female carrying eggs, May 2, 1878; and a young specimen January 20, 1876. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, August, 1878,—the young abundant, the adult females, carrying eggs and young, common, but the adult males rather rare. Casco Bay!, August, 1873: 9 fathoms, sand and mud,—one male and four egg-bearing females; also at other depths; and the young taken at the surface, in the evening. Trenton Bay!, coast of Maine (A. E. Verrill). Halifax!, Nova Scotia, 18 to 20 fathoms, fine sand, stones and red algæ, 1877. Also one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877,—two egg-bearing females. Northumberland Straits, Gulf of St. Lawrence!, 1873 (J. F. Whiteaves).

Diastylis sculptus G. O. Sars.

Diastylis sculpta G. O. Sars, Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 71; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 24, pls. 1 to 9, figs. 1-49, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 554 (260) 1874; Transactions Connecticut Acad., iii, p. 29, 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand; and off Watch Hill!, Rhode Island, 18 fathoms, 1874. I have no record of the dredging of this species in Vineyard Sound, but it was not uncommon in collections made at the surface, during July, August and September, 1871 and 1875. Most of these specimens are females or young and were taken both during the day-time and evening; adult males occurred rarely, however. A single adult specimen of the male was also collected at the surface, at the same locality, in April, 1877, by Vinal N. Edwards. Gloucester Harbor!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Also off Gloucester! and off Cape Ann!, 1878: 26 fathoms, sand, gravel and stones; 35 fathoms, sand; 33 fathoms, sand and gravel. Casco Bay!, 1873; at the surface in the evening; among Laminaria; 9 fathoms, sand and mud; 17 fathoms, mud; 27 to 34 fathoms, hard bottom. Bay of Fundy!: found at low-water mark!, in sandy mud, 1868; at the surface, at low-water mark, and in 4 fathoms, very soft mud, 1872; also in 60 fathoms, mud, off Head Harbor, 1872. Near Halifax!, Nova Scotia, in company with *D. Rathkii* and *D. quadrispinosus*, 20 fathoms, soft mud and fine sand, 1872. Halifax Harbor!, 16, 18 and 21 fathoms, fine sand, stones and red algæ, 1877. About one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles,

1877,—ten large females, all carrying eggs. Northumberland Straits, Gulf of St. Lawrence !, 10 fathoms, sand (J. F. Whiteaves).

Diastylis luciferus Danielssen.

Cuma lucifera Krøyer, Naturhistorisk Tidsskrift. iii. pp. 527. 531, pl. 6, figs. 34–35. 1841; *ibid.*, II, ii, p. 171, 207, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 3, 1849.—Liljeborg, Æfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 119.

“*Diastylis lucifera* Danielssen, Beretning om en zoologisk Reise i Sommeren 1858 i Thronhjemske Vidensk. Selsk. Skrifter, iv, p. 108” (G. O. Sars).—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar. 1864, p. 161: Undersøgelser over Christianiafjordens Dybvandsfauna (extr. Nyt Magazin for Naturvidenskaberne), p. 38, 1869; Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 269 (26); Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer. Kongl. Svenska Vetenskaps-Akad. Handlingar. Stockholm. ix, no. 13, p. 5, 1871.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.

? *Diastylis borealis* Bate, Annals and Magazin Nat. Hist., II, xv, p. 85, pl. 1, fig. 3, 1865 (Port Kennedy, north latitude 72°, west longitude 94°).

Bay of Fundy !, 60 and 77 fathoms, mud, off Head Harbor, August 16, 1872. About ten miles north of Shediac, Gulf of St. Lawrence ! (J. F. Whiteaves). Scandinavia ! (G. O. Sars, et al.)

Diastylis quadrispinosus G. O. Sars.

Diastylis quadrispinosa G. O. Sars, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm. 1871, p. 72; Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer. Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 28, pls. 10, 11, figs. 51–61, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 554 (260), pl. 3, fig. 13, 1874; Transactions Connecticut Acad., iii, p. 28, 1874.

Cuma bispinosa Stimpson, Invertebrata of Grand Manan, p. 30, 1853 (description insufficient. Not the European *Diastylis bispinosa* G. O. Sars (*D. bicornis* Bate)).

Off the coast of New Jersey, north latitude 39° 54', west longitude 73° 15', 30 to 35 fathoms, and off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound !, 17 fathoms, sand and mud, 1874. Off Watch Hill !, Rhode Island, 18 fathoms, 1874. Off Buzzard's Bay ! 29 fathoms, fine sandy mud, common, 1871. Off Martha's Vineyard !, 23 fathoms, 1871. Southwest Ledge !, off Martha's Vineyard, 18 fathoms, 1875. Vineyard Sound, off Tarpaulin Cove !, 10 to 12 fathoms, 1875: Massachusetts Bay !, off Salem, 20 fathoms, gravel and stones, 1877. Off Cape Ann !, Massachusetts, 1878: 26 to 33 fathoms, sand, gravel and stones; 35

fathoms, sand, very abundant. Between Cape Ann and the Isles of Shoals!, 43 to 68 fathoms, mud, 1874. Jeffrey's Ledge!, Gulf of Maine, 51 fathoms, hard sandy mud, 1874. Cosco Bay!, 1873: 16 and 17 fathoms, mud, abundant; 27 fathoms, off Halfway Rock; 45 fathoms, off Seguin Island; also taken with numerous Amphipoda, in 2 fathoms, muddy bottom, in a small trap baited with pieces of fish. Bay of Fundy!, 1868, 1870, 1872. In 1872 it was also dredged in vast numbers at Eel Cove, Grand Menan, in 8 to 10 fathoms, sand, by Prof. H. E. Webster. Off Cape Sable!, Nova Scotia, 75 fathoms, fine sand and mud, 1877. In and near Halifax Harbor!, Nova Scotia, 1872, 1877: 20 fathoms, soft mud and sand; 16 and 18 fathoms, fine sand and red algæ; 21 fathoms, sand, stones and algæ; 42 fathoms, fine sand; 52 fathoms, fine sandy mud. Also about one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877. Northumberland Straits, Gulf of St. Lawrence!, 1873 (Whiteaves).

Upon the coast of northern New England, this is by far the most abundant species of the genus. It is undoubtedly the species which Stimpson called *Cuma bispinosa*, but his description is wholly insufficient to characterize the species and I therefore prefer to retain the more appropriate name proposed by G. O. Sars, who has described and figured the species most admirably. Professor Sars has identified specimens which I have sent to him from different localities on the New England coast.

Diastylis bicornis Bate, is a very different species, of which I have examined European specimens, but which I have never seen upon the American coast.

Diastylis abbreviatus G. O. Sars.

Diastylis abbreviata G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 74; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 30, pl. 12, figs. 62-64, 1871.

Very rare in 30 to 35 fathoms, off the coast of New Jersey, north latitude $39^{\circ} 54'$, west longitude $73^{\circ} 15'$ (Josephine Expedition, Sars). Off Cape Ann!, 35 fathoms, sand, 1878,—one specimen among great numbers of *D. quadrispinosus*. Casco Bay!, 1873: 17 fathoms, mud; also at one other station.

This very pretty species appears to be rare.

Leptostylis longimanus G. O. Sars.

Diastylis longimana G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 173; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 23, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

Leptostylis longimana G. O. Sars, Christianiafjordens Dybvandsfauna, p. 39, 1869 (extr. Nyt Mag. Nat.).

A single female, apparently of this species, was dredged in Caseo Bay!, in 1873. It seems to have been known previously only from the coast of Norway (G. O. Sars).

Leptostylis ampullaceus G. O. Sars.

Cuma ampullacea Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 120.

Diastylis ampullacea G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 175; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

Leptostylis ampullacea G. O. Sars, Christianiafjordens Dybvandsfauna, p. 40, 1869 (extr. Nyt Mag. Nat.); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.

Gulf of Maine, near Cashe's Ledge!, 52 to 90 fathoms, 1873,—a single specimen.

Leucon nasicus Kröyer.

Cuma nasica Kröyer, Naturhistorisk Tidsskrift, iii, pp. 524, 532, pl. 6, figs. 31–33, 1841.

Leucon nasica Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 189, 209, pl. 2, fig. 5a–b, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 2, 1849.—Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 178 (*nasicus*); Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 27 (270).—Whiteaves, Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873] p. 16, [1874?].—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.—Norman, Annals and Magazine Nat. Hist., V, iii, p. 70, 1879 (*nasicus*).

Gulf of St. Lawrence!, 50 and 70 fathoms, 1873 (J. F. Whiteaves). Greenland (Kröyer). Scandinavian coast! (G. O. Sars, Liljeborg). North Sea, coast of Scotland (Metzger). The Minch, west coast of Scotland (Norman).

Leucon nasiconoidis Liljeborg.

Leucon nasiconoides Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 122.—G. O. Sars, Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27).

A single female was dredged at Eastport!, Maine, Bay of Fundy, in 1868. I have also examined one female dredged in the Gulf of St. Lawrence!, by Mr. Whiteaves, in 1873. Scandinavian coast (Liljeborg, G. O. Sars). In life, the specimen from the Bay of Fundy was translucent whitish; the eggs orange.

Eudorella emarginata Norman.

Leucon emarginatus Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 181, 209, pl. 1, fig. 7, pl. 2, fig. 3, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 2, 1849.—Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.

"*Cyrianassa ciliata* Norman, Transactions Tyneside Naturalists' Field Club, v, p. 273, pl. 13, figs. 4-9 (♂) (G. O. Sars); Natural History Transactions of Northumberland and Durham, i, p. 24, 1865.

Eudorella emarginata G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 185; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianiafjordens Dybvandsfauna, p. 42, 1869 (extr. Nyt Magazin for Nat.)

Eudorella emarginata Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Science, 1866, 1867.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27); Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 44, pl. 18, fig. 98, 1871; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 287, 1875.

Off Halifax!, Nova Scotia, 52 fathoms, fine sandy mud, 1877,—two specimens, male and female. Entrance of Gaspé Bay, Gulf of St. Lawrence!, 30 fathoms, 1873 (J. F. Whiteaves). Scandinavian coast! (G. O. Sars, Kröyer, et al.). Scotland! (Norman).

Eudorella hispida G. O. Sars.

Eudorella hispida G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 80; Kongl. Vetenskaps-Akad. Handlingar, ix, no. 13, p. 49, pl. 18, figs. 95-97, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 555 (261), 1874.

Rare in 30 to 35 fathoms, off the coast of New Jersey, north lati-

tude $39^{\circ} 54'$, west longitude $73^{\circ} 15'$ (Josephine Expedition, G. O. Sars). Salem Harbor!, Massachusetts, 5 fathoms, 1873. Off Cape Ann!, 35 fathoms, sand, and 54 fathoms, sand and mud, 1878. Casco Bay!, 1873: 3 fathoms, mud,—both males and females; males also taken at the surface in the evening. Off Casco Bay, about twenty miles east-southeast from Cape Elizabeth, 50 fathoms, mud, 1873. Bay of Fundy!, 1872, abundant in 1 to 4 fathoms, very soft mud,—both males and females.

Eudorella pusilla G. O. Sars.

Eudorella pusilla G. O. Sars, Æfversight Kongl. Vetenskaps-Akad. Förhandlingar. Stockholm, 1871, p. 79; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 46, pls. 16, 17, figs. 76-94, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 554 (260). 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand and mud, 1874, —common, both males and females. Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Casco Bay!, 3, 16, 17 fathoms, mud; 9 fathoms, sand and mud, 1873. Bay of Fundy!, 1872, very abundant in 1 to 4 fathoms, very soft mud; also in 10 to 15 fathoms, mud. Gulf of St. Lawrence!, 1873 (Whiteaves).

Eudorella deformis G. O. Sars.

Leucon deformis Kröyer, Naturhistorisk Tidsskrift, II, ii, p. 194, pl. 2, fig. 4, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5A, fig. 3, 1849.

Eudorella (?) *deformis* G. O. Sars, Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 50, pls. 19, 20, figs. 101 to 118, 1871; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877 (no ?).

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Greenland (Kröyer). Iceland (G. O. Sars). West coast of Norway (G. O. Sars).

Eudorella integra, sp. nov.

An aberrant form, more like *E. deformis* than any other described species of the genus, perhaps generically distinct from the typical species of *Eudorella*.

Female. The cephalothorax is about as long as the abdomen exclusive of the uropods, and regularly and strongly arcuate dorsally.

The carapax, as seen in a side view, is about as long as the first four free segments, nearly three-fourths as high as long, with the dorsal margin approximately parallel with the posterior part of the lateral margins. Both the anterior and posterior portions of the lateral margin are nearly straight, but the anterior portion is directed upward at an angle very oblique to the posterior portion, from which it is separated by a broadly rounded angle. The anterior portion is obscurely denticulate posteriorly but distinctly, though very minutely, toward the slightly prominent anterior angle. The anterior margin is edentate and scarcely at all emarginate; below it is straight and nearly perpendicular, but curved considerably forward above, where the dorsal or inner edges of the lateral lobes are turned abruptly upward at nearly a right angle just in front of the median lobe, to form, as it were, a dorso-frontal rostrum. There is a slight approach to this form of the antero-lateral lobes of the carapax in *E. deformis*, but in that species the dorsal edges of the lobes are prolonged and sharply upturned to form a slender dorsal horn in front of which the edges of the lobes are on a level with, and parallel to, the dorsum back of the horn; while in this new species the whole lateral lobes are prolonged upward and terminate in a slightly incurved edge nearly parallel with the posterior margin of the carapax. The anterior part of the carapax is in fact much as in some of the species of *Leucon*: if the rostrum in *L. nasicoïdes* were edentate and more strongly upturned, it would represent very nearly the form of this part of the front in the present species.

The major flagellum of the antennula is much shorter than the terminal segment of the peduncle; the minor flagellum falls considerably short of the distal end of the first segment of the major flagellum, but is proportionally larger than in *E. deformis*. The first pereopods are proportionally of about the same length as in *E. deformis*, the carpus reaching to or a little beyond a line with the front, and the segments are relatively of about the same length, but the terminal ones are more slender than in that species. The four posterior pairs of pereopods are distally a little more slender than in *E. deformis*, but do not differ essentially in other respects.

The first five segments of the abdomen increase slightly in length posteriorly and are almost entirely naked, wanting wholly the plumose setæ conspicuous beneath the abdomen of *E. deformis*. The sixth segment is about as broad as long, the posterior margin evenly arcuated and armed in the middle with six, or sometimes only four, conspicuous setæ. The basal portion of the uropods is stout, scarcely

longer than the sixth segment of the abdomen, and is furnished with a series of long setæ on the inner margin. The inner ramus is much longer than the base; of its two segments the proximal is much the longer and is armed with six to eight stout spines on the inner margin and with three to five much more slender spines on the outer; the distal segment terminates in a very long and stout spiniform tip, at the base of which there is a long seta on the outside, and upon the inner edge about three spines like those upon the proximal segment. The outer ramus is slightly longer than the inner, tapering, and slightly curved outward at the tip, armed along the inner edge and at the tip with a few long setæ, and on the outer edge and above with a few setæ near the middle.

The *adult males* differ from the females as usual in the genus. The carapax is not as high posteriorly, the lateral margin is more nearly straight, not denticulate anteriorly, the anterior angle rounded, and the frontal margin is very nearly straight throughout. The major flagellum of the antennulæ shows distinctly four segments. The uropods are similar to those of the female, but very much more elongated and armed with more numerous and longer spines and setæ, both of which are, as usual, plumose. The setæ which are so conspicuous upon the posterior margin of the terminal segment of the abdomen of the female, appear to be wholly absent in the male.

Length of adult females, about 5^{mm}; males a very little longer.

Off Halifax!, Nova Scotia, 1877: females carrying eggs common, 42 fathoms, fine sand, and 52 fathoms, sandy mud; also two females from 57 fathoms, stones, sponges and red algæ. About thirty miles south of Halifax!, 110 fathoms, fine sandy mud. Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): both males and females, south of the eastern part of Prince Edward Island, and in 70 fathoms, off the Bay of Chaleurs.

Lamprops quadriplicata, sp. nov.

Female. The cephalothorax is as long as the abdomen exclusive of the telson. The carapax is about as long as the first four of the free segments, and, as seen in a side view, very slightly arcuate dorsally, the front truncated above and with a slight sinus in the frontal margin below it, leaving the antero-inferior angle slightly projecting, but obtuse and evenly rounded, and in most of the specimens armed with three or four very minute teeth. On each side of the carapax there are four, very distinct, arcuate and nearly parallel plications, of which the first is short and extends from the antero-inferior angle to

the side of the median lobe of the carapax; the second extends from the inferior margin a little back of the first to the dorsal line at the back of the median lobe; the third and fourth extend from the inferior margin to the dorsal line, the fourth nearly touching the posterior margin above. The minor flagellum of the antennula is only a little longer than the proximal segment of the major flagellum. The carpus in the first pair of pereopods reaches very nearly to a line with the front of the carapax, and the carpus, propodus and dactylus are sub-equal in length. The second pereopods do not quite reach a line with the front, the dactylus and propodus are about equal in length and together about equal to the length of the carpus, which is very slightly longer than the merus. The rudimentary exopods of the third and fourth pereopods have three or four plumose setæ at the tip and several more upon the proximal segment. The basal portion of the uropods is as long as the telson and armed with about ten spines upon the inner margin: the inner ramus is about as long as the basal portion; the first segment is longer than the second and third together and is armed with about sixteen spines on the inner and two or three on the distal part of the outer margin; the second with four or five spines on the inner margin and one at the distal extremity of the outer; the third or terminal with two upon the inner margin and three at the tip: the outer ramus is a little shorter than the inner and its two segments are sub-equal in length. The telson is as long as the fifth segment of the abdomen and about twice as long as the sixth segment, and is armed with either two or three spines upon the distal portion of each lateral margin and at the tip with five spines of about the same size as the marginal ones, though the median is a little larger than the others.

Length 9^{mm}.

Smaller, immature females differ in having the anterior pairs of pereopods proportionally shorter than in the adult, and in having fewer spines on the uropods.

The only male seen is about 8½^{mm} long and not fully mature, although the antennæ are as long as the cephalothorax and the exopods of the third and fourth pairs of pereopods are fully developed, but there is no indication whatever of rudimentary pleopods. From this fact it seems probable that the adult male is wholly without pleopods, and that this species represents a genus distinct from *Lamprops*.

I have seen only the male just referred to, one female with eggs and a few immature females. Gloucester Harbor!, Massachusetts, 7

to 10 fathoms, sand and red algæ, 1878; Casco Bay!, 1873,—a single immature female taken at the surface in the evening.

Campylaspis rubicunda G. O. Sars.

Cuma rubicunda Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.

Campylaspis rubicunda G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 202; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianafjordens Dybvandsfauna, p. 44, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 272 (29); Om Cumaceer fra de store dybder i Nordishavet, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 10, pl. 4, figs. 14–16, 1873.—Norman, in Jeffreys, Valorous Cruise, Proceedings Royal Society, London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist., V, iii, p. 73, 1879.

Off Cape Ann!, Massachusetts, 35 fathoms, sand, 1878. Casco Bay!, stomach of the common flounder (*Pseudopleuronectes Americanus*). Greenland (Norman). Coast of Scandinavia (Liljeborg, G. O. Sars).

Pelagic species found near the borders of the Gulf Stream off St. George's Banks.

The following pelagic species, characteristic of the fauna of the Gulf Stream, were taken, in 1872, east of St. George's Banks, north latitude $41^{\circ} 20'$ to $30'$, west longitude 65° to $65^{\circ} 30'$, and should perhaps be mentioned here, though they in no sense belong to the coast fauna north of Cape Cod. Most, if not all, these semi-tropical pelagic species are, however, occasionally found in summer along the south coast of New England, and the coast of the Middle and Southern States.

Nautilograpsus minutus Milne-Edwards.

Cancer minutus Linné, Systema Naturæ, edit. 12, i, p. 1040, 1767.—J. C. Fabricius, Systema Entomologiæ, p. 402, 1775; Entomologia systematica, ii, p. 443, 1793; Supplementum Entom. syst., p. 343, 1798.

Grapsus minutus Latreille, Hist. nat. Crust. et Insectes, vi, p. 68, 1803.

Grapsus cinereus Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 99, 1817 (not

Grapsus cinereus Bosc, nor *Grapsus* (*Sesarma*) *cinereus* Say, loc. cit., p. 442, 1818).

Grapsus pelagicus Say, loc. cit., p. 442, 1818.

Nautilograpsus minutus Milne-Edwards, Hist. nat. Crust., ii, p. 99, 1837; Annales des Sci. nat., Paris, III, xx, p. 174 (140), 1850.—Goodsir, Annals Magazin Nat. Hist., xv, p. 73, pl. 7, fig. 1, 1845.—Gibbes, Proceedings American Assoc. Adv. Sci.,

3d meeting, p. 182 (18), 1850.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 103 (49); Annals Lyceum Nat. Hist. New York, vii, p. 231 (103), 1860.—Heller, Crustaceen des südlichen Europa, p. 114, 1863.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.

Planes Linnaëana Bell, British Stalk-eyed Crust., p. 135 (cut), 1844.—White, List of Crust. British Museum, p. 41, 1847; Catalogue of British Crust. Brit. Museum, p. 19, 1850.

Planes minutus Dana, United States Exploring Expedition, Crust., p. 346, 1852.

Gulf of Mexico (Gibbes); Bermuda! (G. Brown Goode); and throughout the warmer parts of the North Atlantic and occasionally upon the English coast (White, Bell, et al.). Mediterranean (Heller). Cape St. Lucas (Stimpson). Indian Ocean (Milne-Edwards).

Neptunus Sayi Stimpson.

Portunus pelagicus Bosc, Hist. nat. des Crust., p. 219, pl. 5, fig. 3, 1805.

Lupa pelagica Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 97, 1817.—DeKay, Nat. Hist. New York, Crust., p. 11, pl. 6, fig. 8, 1844.

Lupa Sayi Gibbes, Proceedings American Assoc. Adv. Sci., 3d meeting, p. 178 (14), 1850.—Dana, United States Exploring Expedition, Crust., p. 273, pl. 16, fig. 8, 1852.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 38 (36).

Neptunus Sayi Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 220 (92), 1860; Bulletin Museum Comp. Zoology, Cambridge, i, p. 147, 1870.—A. Milne-Edwards, Archives du Muséum d'Hist. Nat., x, p. 317, pl. 29, fig. 2, 1861.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 319 (4), 1878.

Gulf Stream!, from the Straits of Florida (Stimpson) to north latitude 41° 30' (1872) and probably much further, both north and south.

Latreutes ensiferus Stimpson.

Hippolyte ensiferus Milne-Edwards, Hist. nat. des Crust., ii, 374, 1837.—Krauss, Südafrikanischen Crustaceen, p. 56, 1843.—Goodsir, Annals and Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 2, 1845.—Dana, United States Exploring Expedition, Crust., p. 562, 1852.

Latreutes ensiferus Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 27 (96), 1860.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 56, 1878.

Bermuda! (G. Brown Goode). Various points in the Gulf Stream!. Near the Azores (Milne-Edwards). African coast (Krauss).

Leander tenuicornis Kingsley.

Palæmon tenuicornis Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 249, 1818.—DeKay, Nat. Hist. New York, Crust., p. 30, 1844.—White, List of Crust. British Museum, p. 78, 1847.

Palæmon tenuirostre Milne-Edwards, Hist. nat. des Crust., ii. p. 395, 1837 (evidently a mistake for *tenuicornis*).

Palæmon natator Milne-Edwards, op. cit., ii, p. 393, 1837.

Palæmon natator Goodsir, Annals Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 3, 1845.—White, List of Crust. British Museum, p. 77, 1847.—Dana, United States Exploring Expedition, Crust., p. 588, pl. 38, fig. 11, 1852.—Heller, Crustaceen des südlichen Europa, p. 268, pl. 9, figs. 11, 12, 1863.

Leander erraticus Desmarest, Annales Soc. Entomologique de France, II, vii, p. 92, cut, 1849.

Leander natator Stimpson. Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 40 (109).

Leander tenuicornis Smith, MSS.—Kingsley, Bulletin Essex Institute, Salem, x, p. 66, 1878.

Off Gaudeloupe (Desmarest). Various parts of the Gulf Stream! Bermuda!, (G. Brown Goode). North latitude $41^{\circ} 25'$, west longitude $66^{\circ} 20'$! (1872). Banks of Newfoundland (Say).

Siriella? sp.

A single immature female, apparently belonging to this genus, was taken east of St. George's Banks, latitude $41^{\circ} 25'$, longitude $65^{\circ} 10'$, by Mr. Harger and myself, September 15, 1872.

Lucifer sp.

Taken at the same time and place as the last species.

On the Geographical Distribution of the foregoing species, and on the Relation of the Fauna of the Atlantic coast of North America north of Cape Cod to that of Greenland and Europe.

In order to exhibit in a connected manner the principal facts in regard to the geographical and bathymetrical distribution of the species properly belonging to the marine fauna of our coast north of Cape Cod, I have prepared the following tabular synopsis.

The headings of a part of the eleven columns, in which the geographical distribution is indicated, do not state fully the region included, so that the following explanations are necessary. Under "South of Cape Cod," all those species are included which are found

anywhere near the south coast of New England or the coast still further south, whether they properly belong to the fauna south of the Cape or are northern species which occur only in exposed situations, in deep water, or in winter; but to distinguish these two classes of species, the northern ones are indicated by an asterisk (*). Under "Massachusetts Bay," two or three rare species taken off Cape Ann, but not as yet actually in the Bay, are included. Under "Nova Scotia," only those species which have been observed on or near the southeast coast are included; the species of the northern, or Gulf-of-St. Lawrence, coast being included in the eighth column, while a few species taken only in deep water (one hundred or more fathoms) far off the Atlantic coast, are included in the seventh column. Under "Gulf of Maine, etc.," are included the species found in the Gulf of Maine proper (the great region of comparatively deep water, but with numerous banks and "ledges," between St. George's Banks and the shallow waters of the coast from Cape Cod to Nova Scotia), and also the species found on St. George's Banks, LeHave Bank, etc., and the deep waters outside of them. Under "Gulf of St. Lawrence and Labrador," are included the species found in the Gulf and on the east, or Atlantic, coast of Labrador, though in the present list all the species known from the east coast of Labrador have been found also in the Gulf. A few species which have been found in the shallow southwestern part, including Northumberland Straits and the Bay of Chaleurs, and not in other parts of the Gulf, are indicated by a dagger (†). Under "Bering Sea," species known from any part of the North Pacific or from the Arctic Ocean immediately north of Bering Straits are included. The number of species common to this region and the North Atlantic will undoubtedly be very largely increased by subsequent investigation.

In checking in the table the occurrence of the species, a mark of affirmation (!) is used, as in the previous pages, when I am myself responsible for the identification of the species; the plus sign (+), when the species has not been seen by me but has been recorded on good authority; and by a mark of interrogation (?), when there is doubt in regard to the identification of the species.

In the bathymetrical distribution, under "Fathoms," the depths within which the species have been found upon our coast only are given.

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Gelasimus pugnax</i>	!	!		/								Shore.
<i>pugillator</i>	!	!										"
<i>Callinectes hastatus</i>	!		+									0- 2
<i>Platyonichus ocellatus</i>	!	!										0- 10
<i>Carcinus mænas</i>	!	!								!		0- 2
<i>Geryon quinquedens</i>							!					100-160
<i>Panopeus depressus</i>	!	!										0- 5
<i>Sayi</i>	!	!										0- 5
<i>Harrisii</i>	!		!									0-
<i>Cancer irroratus</i>	!	!	!	!	!	!	!	!				0- 50
<i>borealis</i>	!		!	!	+	+						0- 10
<i>Chionæcetes opilio</i>							!	!	+		!	88-101
<i>Hyas araneus</i>			!	!	!	!	!	!	!	!	+	16- 60
<i>coarctatus</i>	!*		!	!	!	!	!	!	+	!		0-150
<i>Libinia emarginata</i>	!	!	!	!								0- 5
<i>Lithodes maia</i>			!	!			!	+	?	!		50-250
<i>Eupagurus bernhardus</i>	!*		!	!	!	!	!			!	+	0-150
<i>longicarpus</i>	!	!	+	!								0- 10
<i>pubescens</i>	!*		!	!	!	!	!	!	+	+	+	0-150
<i>Krøyeri</i>			!	!	!	!	!	!	+	!	+	8-430
<i>Parapagurus pilosimanus</i>							!					250
<i>Munidopsis curvirostra</i>							!					180-220
<i>Homarus Americanus</i>	!	!	!	!	!	!	!					0- 10
<i>Axius serratus</i>			+				!					20- 40
<i>Calocaris Macandree</i>								+		+		190-
<i>Crangon vulgaris</i>	!	!	!	!	!	!	!	!		!		0- 48
<i>boreas</i>			!	!	!	!	!	!	+	!	+	0- 33
<i>Sabinea septemcarinata</i>			!	!	!	!	!	!	+	!	?	26- 68
<i>Sarsii</i>							!			!		60-112
<i>Pontophilus Norvegicus</i>						!	!			!		101-115
<i>Nectocrangon lar</i>						!		!	+		+	29- 59
<i>Caridion Gordoni</i>				!	!	!				!		27-110
<i>Hippolyte Fabricii</i>			!	!	!	!	!	!	+		+	0- 64
<i>Gaimardii</i>			+	!	!	!		!	+	!	+	0- 57
<i>spinus</i>			!	!	!	!	!	!	+	!	+	0- 90
<i>securifrons</i>			!		!	!				!		27-190
<i>macilenta</i>					!		!	+				26- 70
<i>Phippsii</i>			!	!	!	!	!	!	+	!	+	10-125
<i>pusiola</i>	!*		!	!	!	!	!	!		!		0-105
<i>polaris</i>			!	!	!	!	!	!	+	!	+	10-100
<i>Groenlandica</i>			!	!	!	!	!	!	+		+	6- 33

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Pandalus borealis</i>		!	!		!	!		+	!	+		40-160
<i>Montagui</i>	!*	!	!	!	!	!	!	+	!			10-430
<i>Palæmonetes vulgaris</i>	!	!										
<i>Pasiphaë tarda</i>							!	+	!			140-175
<i>Thysanopoda Norvegica</i>		!	!	!	!	!	!	+	!			0-430
<i>inermis</i>	!*	!		!		!	!	+	!			0-220
<i>Erythrops Goësii</i>		!								!		20- 48
<i>Meterythrops robusta</i>		!					!					33- 70
<i>Pseudomma roseum</i>							!	!		!		105-210
<i>truncatum</i>							!					45- 70
<i>Heteromysis formosa</i>	!	!										0- 10
<i>Mysis mixta</i>		!	!	!		!		+	?	!		20- 90
<i>stenolepis</i>	!	!	!		!							0- 18
<i>oculata</i>				?			!	+	+			0-
<i>Americana</i>	!	!	!									0- 5
<i>Diastylis Rathkii</i>					!	!	!	+	!			20- 57
<i>politus</i>	!	!	!		!	!	!	!				0-190
<i>sculptus</i>	!	!	!	!	!	!	!	!				0-190
<i>luciferus</i>				!	!		!			!		60- 97
<i>quadrispinosus</i>	!*	!	!	!	!	!	!	!				2-190
<i>abbreviatus</i>	+	!	!									17- 35
<i>Leptostylis longimanus</i>				!						+		
<i>ampullaceus</i>						!				+		52- 90
<i>Leucon nasicus</i>							!	+	!			50- 70
<i>nasicoides</i>				!			!	!	+			
<i>Eudorella emarginata</i>					!	!	!			!		52
<i>hispida</i>	+	!	!	!		!						1- 54
<i>pusilla</i>	!	!	!	!			!	!				1- 25
<i>deformis</i>	+*	!						+	+			25
<i>integra</i>					!	!	!					42-110
<i>Lamprops quadruplicata</i>		!	!									0- 10
<i>Campylaspis rubicunda</i>		!	!					+	+			35

A simple summation of the columns of the above table gives the following as the number of species found in the whole region under discussion, and the number of these species recorded from the regions specified :

	Number of species in list.	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scôtia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.
Brachyura,	15	12	8	7	5	4	4	5	4	3	3	2
Anomura,	7	3	1	5	5	3	3	5	4	2	4	3
Macrura,	23	5	2	16	13	12	17	17	15	13	16	9
Total Decapoda,	45	20	11	28	23	19	24	27	23	18	23	14
Schizopoda,	11	4		8	4	3	2	4	6	4	6	
Cumacea,	17	7		9	9	6	6	6	10	4	9	
Total,	73	31	11	45	36	28	32	37	39	26	38	14

This summation, however, does not fairly represent the Thoracos-tracan fauna of our northeastern coast, since it takes no account of the rare or accidental occurrence of species outside their regular habitats, and, in particular, because it takes no account of the occurrence of species, under favorable local conditions, far north and south of their ordinary limits.

As has been previously remarked, the fauna of Cape Cod Bay is an extension of the southern, or Virginian, fauna across Cape Cod, and should properly be excluded from the fauna of the coast of northern New England. Although the crustacean fauna of Cape Cod Bay is very poorly represented in the previous list, the number of species recorded is sufficient to illustrate its southern character, which is abundantly proved by the other classes of its inhabitants. Of the eleven species recorded from Cape Cod Bay, the following have not been recorded from elsewhere north of the Cape and do not, in any sense, belong to the fauna of northern New England :

Gelasimus pugnax.	Carcinus mænas.	(1.)
G. pugilator.	Panopeus depressus.	
Platyonichus ocellatus.	P. Sayi.	

With the single exception of the apparently cosmopolitan *Carcinus*, these species represent the extreme northern limit, on our coast, of the genera to which they belong, and of the genera themselves none

appear to be represented in the European Seas. Of the five other species recorded from Cape Cod Bay, all are common far to the south and none of them are truly arctic species, although a single one, *Crangon vulgaris*, extends north to the Gulf of St. Lawrence and to Europe.

The following, in addition to list (1), are southern species occurring north of Cape Cod Bay only accidentally or in exceptionally protected localities:

Callinectes hastatus.	Palæmonetes vulgaris.	(2.)
Panopeus Harrisii.	Heteromysis formosa.	
Libinia emarginata.	Mysis Americana.	
Eupagurus longicarpus.		

Excluding the species in lists (1, 2), there are left eighteen northern species which extend south of Cape Cod. Of these,

Hyas coarctatus,	Pandalus Montagu,	(3.)
Eupagurus bernhardus,	Thysanopoda inermis,	
E. pubescens,	Eudorella deformis,	
Hippolyte pusiola,		

are northern and European species which extend but a short distance south of Cape Cod, where they are found usually only in cool waters of exposed localities, or, in the case of *Thysanopoda inermis*, only in winter.

Of the eleven remaining species which occur both north and south of Cape Cod,

Cancer irroratus.	Crangon vulgaris,	(4.)
C. borealis,	Mysis stenolepis,	
Homarus Americanus,		

have about equally extensive ranges and are about equally common both north and south of Cape Cod, and must be regarded as belonging properly to both faunæ. The others,

Diastylis politus,	Diastylis abbreviatus,	(5.)
D. sculptus,	Eudorella hispida,	
D. quadrispinosus,	E. pusilla,	

are all Cumacea which may fall in the same category as the four preceding species, although it is probable that some or perhaps all of them will be found to belong more exclusively to the northern fauna. None of the species in the last two lists are known to extend far north, nor, with the exception of *Crangon vulgaris*, to Europe, although they all belong to genera well represented in European seas.

Excluding, from the number of species recorded from both north and south of Cape Cod Bay, the seven southern species (2) which

occur locally or accidentally north, and the seven southern species (3) which occur similarly south of Cape Cod, there are left only eleven species (4, 5) which can be properly regarded as common to two regions of the New England coast. This fairly represents, I think, the marked difference between the two faunæ; a difference due principally to the difference in the temperature of the water, but partially undoubtedly, to the different structure of the coast and to the different nature of the shore and bottom in the two regions.

That there is no similar change in the fauna of the coast and shallow waters from Massachusetts Bay to Labrador is well shown by a comparison of the fauna of Massachusetts and Casco Bays with the fauna of the Gulf of St. Lawrence at similar depths. Omitting the southern species of lists (1, 2) and also the deep-water species (8) which are ordinarily not found at depths less than fifty fathoms, the following species are left recorded from Massachusetts and Casco Bays; those not yet recorded from the Gulf of St. Lawrence being prefixed by an asterisk:

Cancer irroratus.	Hippolyte Grœnlandica.	(6.)
*C. borealis.	*Pandalus borealis.	
Hyas araneus.	P. annulicornis.	
H. coarctatus.	Thysanopoda Norvegica.	
*Eupagurus bernhardus.	T. inermis.	
E. pubescens.	*Erythrops Goëssii.	
E. Krøyeri.	Metythrops robusta.	
Homarus Americanus.	*Mysis mixta.	
*Axius serratus.	*M. stenolepis.	
Crangon vulgaris.	Diastylis politus.	
C. boreas.	D. sculptus.	
Sabinea septemcarinata.	D. quadrispinosus.	
*Caridion Gordoni.	*D. abbreviatus.	
Hippolyte Fabricii.	*Leptostylis longimanus.	
H. Gaimardii.	*Eudorella hispida.	
H. spinus.	E. pusilla.	
*H. securifrons.	*E. deformis.	
H. Phippsii.	*Lamprops quadriplicata.	
H. pusiola.	*Campylaspis rubicunda.	
H. polaris.		

This list contains all the species recorded from less than fifty fathoms in the Bay of Fundy (unless *Mysis oculata* or *Leucon nasicoïdes* may prove to be exceptions), and is, as far as known, a complete list of the species which should be regarded as the regular inhabitants of the coast region of northern New England. Only six species additional to this list are recorded from the Gulf of St. Lawrence; they are the following:

Nectocrangon lar.	Mysis oculata.	(7.)
Hippolyte macilenta.	Diastylis Rathki.	
Pseudomma truncatum.	Leucon nasicoides.	

With the exception of the new species of *Pseudomma*, these are all thoroughly arctic species, and show a slight increase in the arctic character of the fauna of the Gulf of St. Lawrence over that of northern New England. The *Nectocrangon*, the *Hippolyte*, and the *Diastylis* were found also upon the Atlantic coast of Nova Scotia and may, very likely, yet be found on the New England coast; while the *Leucon* is already known from the Bay of Fundy and will doubtless yet be found in Casco and Massachusetts Bays.

The fifteen species from Massachusetts and Casco Bays (6) not yet recorded from the Gulf of St. Lawrence afford very little evidence in regard to the relations of the fauna of the Gulf, for some of them are known to be arctic and will undoubtedly be found in the Gulf, and the distribution of most of the others is not sufficiently well ascertained to be used as evidence. The absence of *Eupagurus bernhardus* from the Gulf of St. Lawrence and Greenland, while it occurs on the New England coast, in Europe, and in the North Pacific is, however, an interesting fact which should not be overlooked.

The shallow southwestern part of the Gulf of St. Lawrence, including the region of Northumberland Straits, etc., as shown particularly by its Molluscan fauna, is much more southern in its character than the rest of the Gulf; but too little is known of the stalk-eyed crustaceans of this region to illustrate the fact, or to affect the statements above made in regard to the fauna of the Gulf as a whole, for the species which are recorded from this part of the Gulf only are all Cumacea of which the distribution is not sufficiently known to make their occurrence here evidence in regard to the character of the fauna.

The deep-water species, or those which have not been recorded from less than fifty fathoms on our coast, and which are not inserted in lists (6, 7), are the following; those known from the Gulf of Maine, from off the coast of Nova Scotia, etc., being indicated by an *m*; those from the Gulf of St. Lawrence, by an *L*:

<i>m</i> Geryon quinquedens.	<i>m</i> Pasiphaë tarda.	(8.)
<i>m L</i> Chionæcetes opilio.	<i>m</i> Pontophilus Norvegicus.	
<i>m L</i> Lithodes maia.	<i>m L</i> Pseudomma roseum.	
<i>m</i> Parapagurus pilosimanus.	<i>m L</i> Diastylis luciferus.	
<i>L</i> Munidopsis curvirostra.	<i>m</i> Leptostylis ampulaceus.	
<i>L</i> Calocaris Macandreae.	<i>m L</i> Leucon nasicus.	
<i>m</i> Sabinea Sarsii.	<i>m L</i> Eudorella emarginata.	

The differences between the deep-water faunæ of the two regions, as shown in this list, are probably wholly accidental, the species which are not known to be common to both regions, being new or, at least on the western side of the Atlantic, little known species which will, most likely, eventually be found to inhabit both regions.

The facts above presented show conclusively, I think, that, as far as the Thoracostraca are concerned, the fauna from Cape Cod Bay to Labrador is essentially a continuous one, or at least that there are no changes in it comparable with the differences between the fauna south and that north of Cape Cod Bay. An uncompleted investigation of the distribution of the Amphipoda sustains these conclusions, which appear to be essentially in harmony with the facts at present known in regard to the distribution of the Mollusca and of other groups of the better known marine animals of the region in question.

Of the fauna of the east, or Atlantic, and of the north coast of Labrador, very little is at present known, but I believe no species of crustaceans, which are not found also in the Gulf of St. Lawrence or further to the south, have been recorded from this region, and the very close resemblance between the fauna of the northern part of the Gulf and that of the Greenland seas (to which I shall presently allude) renders it very improbable that the fauna of the east and north coasts of Labrador differs essentially from that of the northern part of the Gulf of St. Lawrence. The close relationship existing between the marine fauna of Greenland and that of northern Europe has long been observed and fully admitted by European zoologists, but the similarly close relationship between the marine fauna of Greenland and that of the coasts of the continent of North America itself, as well as the similar relationship between the fauna of the latter region and that of the seas of northern Europe, has not been so generally recognized by them and has recently been strenuously controverted.* This has probably been largely due to the fact that

* Dr. J. Gwyn Jeffreys: Preliminary Report of the Biological Results of a cruise in H. M. S. *Valorous* to Davis Strait in 1875, Proceedings Royal Society, London, vol. xxv, p. 188, 1876.

The Rev. A. M. Norman, however, appears to have fully recognized the true relation between the faunæ of the eastern and western sides of the North Atlantic, and also the American rather than the European character of the fauna of the Greenland seas; and in this very report arrives at conclusions the reverse of those of Mr. Jeffreys. Mr. Norman has, in a letter received since these pages were written, very kindly communicated to me his general conclusions in regard to the fauna of the North Atlantic, and I am pleased to find that his investigations in nearly all the classes of marine Invertebrata, have led to conclusions essentially the same as those resulting from my special study of the Thoracostraca.

the Greenland fauna has been studied almost exclusively by European zoologists to whom the fauna of our coast has usually been very little known. The earlier American zoologists fell into the same error, and, being without specimens of the known European species for comparison, and without sufficiently accurate figures or descriptions, described as new species already known from European and Greenlandic seas. This process has sometimes been reversed, however, the species being first described from our coast and later from the European. But the crustaceans have been more fortunate in this respect than some other classes of animals.

Further on, I have discussed the facts in regard to the geographical distribution of the Thoracostraca of Greenland, and need not specially allude to them here. The relation of the Thoracostracan fauna of the region between Cape Cod and Labrador to that of Greenland, that of Europe, and that of the region of Bering Sea, is shown in a general way in the summary, previously given, of the table of distribution (A), but is better shown if we omit from the summary the southern species (1, 2) which properly have no place in the fauna. Rejecting these, there are left belonging to the fauna between Cape Cod Bay and Labrador, sixty species, of which twenty-six are known in Greenland, thirty-seven in Europe, and fourteen in the region of Bering Sea. This is shown for different groups of Thoracostraca, in the following table:

(B.)	Cape Cod to Labrador.	Greenland.	Europe.	Region of Bering Sea.
Brachyura -----	6	3	2	2
Anomura -----	6	2	4	3
Macrura -----	22	13	16	9
Total Decapoda -----	34	18	22	14
Schizopoda -----	9	4	6	
Cumacea -----	17	4	9	
Total -----	60	26	37	14

This shows that a little more than three-fifths (sixty-one per cent.) of the species known to our northern marine fauna are common to the European fauna, while over two-fifths (forty-three per cent.) are found in Greenland, and that the proportions are very nearly the same if

the comparison be restricted either to the Decapoda proper, the Schizopoda, or the Cumacea.

The numerical distribution of the above twenty-six species known to be Greenlandic, along the western side of the North Atlantic is shown in the last five columns of table (D) beyond.

The similar distribution of the thirty-seven species common to our fauna and that of the European seas, and also the whole number of species recorded from each of the regions included in the second, third, fourth and fifth columns, is given in the following table, in which the fifth column is made to include the number of species found at less than fifty fathoms along the New England coast north of Cape Cod, while the other columns include the same regions as in table (A):

(C.)	Europe.	Greenland.	G. St. Lawrence.	G. of Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod.	Region of Bering Sea.
Brachyura	2	2	2	2	2	1	1
Anomura	4	2	3	4	4	1	3
Macrura	16	9	10	14	12	3	6
Total Decapoda	22	13	15	20	18	5	10
Schizopoda	6	4	4	4	4	1	
Cumacea	9	4	5	1	6	1	
Total European	37	21	24	25	28	7	10
Whole no. recorded		36	39	37	42		

Comparing the number of European species found in each of the four regions north of Cape Cod, with the whole number of species recorded from each of these regions, as given in the last line of the table, it will be seen that the proportion of European species is very nearly the same in each of the regions, while south of Cape Cod there is a very sudden diminution in the number of European species.

Thirty of the thirty-seven species common to the two sides of the North Atlantic are known to occur on our coast in fifty fathoms or less, while some of the remaining species are recorded from equally shallow water in the European seas. This is a smaller proportion of deep-water species than is found among the species which are left as peculiar to the fauna between Cape Cod and Labrador, which shows that the species common to Europe and America are not predominantly deep-water species.

In the following list of the twenty-three species belonging to the fauna between Cape Cod and Labrador and not known to be European, those which are known to be true arctic species are indicated by an A; those which extend south of Cape Cod and appear to have their center of distribution on the New England coast are indicated by an s, but some of the Cumacea thus indicated may very likely prove to be arctic species.

Geryon quinquedens.	A Hippolyte Groenlandica. (9.)
s Cancer irroratus.	Meterythrops robusta.
s C. borealis.	Pseudomma truncatum.
A Chionæcetes opilio.	s Mysis stenolepis.
Parapagurus pilosimanus.	s Diastylis politus.
Munidopsis curvirostra.	s D. sculptus.
s Homarus Americanus.	s D. quadrispinosus.
Axius serratus.	s D. abbreviatus.
A Nectocrangon lar.	s Eudorella hispida.
A Hippolyte Fabricii.	s E. pusilla.
A H. macilenta.	E. integra.
	s Lamprops quadriplicata.

Excepting *Axius serratus* (which will very likely prove to be specifically identical with the European species), the species not prefixed by either A or s, are all new or recently described and little is yet known of their geographical range, but they are probably arctic species. It is worthy of notice that, of the five species known to be arctic and not known to be European, all are Greenlandic and all but one (*Hippolyte macilenta*) are also known to occur on the western coast of North America, in the region of Bering Sea. These four species, common to both the northern Atlantic and northern Pacific coasts of North America are all conspicuous forms not likely to escape detection, and their geographical distribution apparently indicates that there are a certain number of arctic American species which are not European—perhaps because they are too arctic to be European.

The relation of the Thoracostracan Fauna of Greenland to that of the rest of North America and to that of Europe.

In order to exhibit clearly the similarity of the relation of the Thoracostracan fauna of Greenland, on the one hand, to the fauna of the rest of the North American seas, and, on the other hand, to that of the European seas, I have compiled the following list of the species of Thoracostraca known to inhabit the Greenland coast, and have given in foot-notes the principal synonyms, the most important refer-

ences, and the geographical distribution, for the species not known from the region between Cape Cod and Labrador, and consequently not treated of in the foregoing pages, where the geographical distribution of all the other species is given. The species known from the eastern coast of North America are indicated by the letters E. A. (all these occur in the Gulf of St. Lawrence or further south); those from the western coast (the region of Bering Sea, etc.) by the addition of the letter W.; those from the European coast by the letter E.

Chionecetes opilio,	E. & W. A.		H. macilentia,	E. A.	
Hyas araneus,	E. & W. A.	E.	H. Phippsii,	E. & W. A.	E.
H. coarctatus,	E. A.	E.	H. polaris,	E. & W. A.	E.
Eupagurus pubescens,	E. & W. A.	E.	H. Grœnlandica,	E. & W. A.	
E. Krøyeri,	E. & W. A.	E.	H. microceras.†		
Orangon boreas,	E. & W. A.	E.	H. Panschii.‡		
Sabinea septemcarinata,	E. & W. (?) A.	E.	Pandalus borealis,	E. & W. A.	E.
Nectocrangon lar,	E. & W. A.		P. Montaguï,	E. A.	E.
Hippolyte Fabricii,	E. & W. A.		Hymenodora glacialis,§		E.
H. Gaimardii,	E. & W. A.	E.	Pasiphaë tarda,	E. A.	E.
H. incerta,*			Sergestes arcticus,||		
H. spinus,	E. & W. A.	E.			

* HIPPOLYTE INCERTA Buchholz, Zweite deutsche Nordpolfahrt, ii. p. 272, 1874.
East Greenland (Buchholz). Perhaps only a variety of *H. Gaimardii*.

† HIPPOLYTE MICROCERAS Krøyer, Naturhistorisk Tidsskrift, iii. p. 578, 1841: Monografisk Fremstilling af Slægten Hippolyte's nordiske Arter, Kgl. danske Vidensk. Selsk. Skr., naturvidensk. mathem. Afl., ix. p. 341 (*microceras*), pl. 5. fig. 105–109 (*microceras*), 1842.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.
Greenland (Krøyer).

‡ HIPPOLYTE PANSCHII Buchholz, Zweite deutsche Nordpolfahrt, ii. p. 277, pl. 1, fig. 1, 1874.—Kingsley, Bulletin Essex Institute, Salem, x. p. 62, 1878.
East Greenland (Buchholz).

§ HYMENODORA GLACIALIS G. O. Sars.

Pasiphaë glacialis Buchholz, Zweite deutsche Nordpolfahrt, ii. p. 279, pl. 1, fig. 2, 1874.—Kingsley, Bulletin Essex Institute, Salem, x. p. 69, 1878 (*Pasiphaea*).

Hymenodora glacialis G. O. Sars, Archiv for Mathematik og Naturvidenskab, Kristiania, ii. p. 341, 1877.

East Greenland (Buchholz). Deep water off the coast of Norway (G. O. Sars).

|| SERGESTES ARCTICUS Krøyer, Oversigt Kgl. danske Vidensk. Selsk. Forhandlinger, Kjöbenhavn, 1855, p. (6); Forsög monog. Fremstil. Kræbsdyrslægten Sergestes, Kgl. danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afl., iv. pp. 240, 276, pl. 3, fig. 7, pl. 5, fig. 16, 1859.
Greenland (Krøyer).

Thysanopoda Norvegica,	E. A.	E.	Diastylis Rathkii,	E. A.	E.
T. inermis,	E. A.	E.	D. Edwardsii, §		
T. longicaudata,*			D. resimus, ||		
T. Raschii, †		E.	Leucon nasicus,	E. A.	E.
? Mysis mixta,	E. A.	E.	Eudorella deformis,	E. A.	E.
M. oculata,	E. A.	E.	Campylaspis rubicunda,	E. A.	E.
Boreomysis arctica, ‡		E.			

The following table gives a numerical summary of this list, and also the numerical distribution of the species in several regions along the eastern coast of the continent of North America.

* THYSANOPODA LONGICAUDATA Kröyer, in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 8, fig. 1, 1849.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.
Greenland (Reinhardt, Lütken).

† THYSANOPODA RASCHII Sars, Christiania Videnskabs-Selskabs Forhandling, 1863, p. 83.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.
Coast of Norway (Sars). East Greenland (Buchholz).

‡ BOREOMYSIS ARCTICA G. O. Sars.

Mysis arctica Kröyer, Et Bidrag til Kundskab om Kiebsdyrfamilien Mysidæ, Naturhistorisk Tidsskrift, III, i, pp. 34, 42, pl. 1, fig. 5, 1861.

Boreomysis arctica G. O. Sars, Christianiafjordens Dybvandsfauna, p. 26, 1869 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 264 (21).—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Greenland (Kröyer). West coast of Norway (G. O. Sars, Metzger).

§ DIASTYLIS EDWARDSII Kröyer.

Cuma Edwardsii Kröyer, Naturhistorisk Tidsskrift, iii, pp. 504, 531, pl. 5, figs. 1-16, 1841; op. cit., II, ii, pp. 128, 207, pl. 1, figs. 1, 3, 5, 9-14, 1846; in Gaimard, Voyages en Scandinavie, etc., pl. 4, 1849 (♀).

Cuma brevirostris Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 174, 208, 1846; Voyages en Scandinavie, etc., pl. 5A., fig. 1, 1849 (adult ♂).

Diastylis Edwardsii G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.—Norman, Proceedings Royal Soc., London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist. V, iii, p. 61, 1879.

Greenland (Kröyer, Norman).

|| DIASTYLIS RESIMUS G. O. Sars.

Cuma resima Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 165, 206, 1846; Voyages en Scandinavie, etc., pl. 3, fig. 1, 1849.

Diastylis rasima G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.

Greenland (Kröyer).

(D.)	Greenland.	Europe.	Eastern coast of North America.	G. St. Lawrence.	G. Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod. Region of Bering Sea.
Brachyura.....	3	2	3	3	3	2	1
Anomura.....	2	2	2	2	2	2	3
Macrura.....	18	10	13	11	11	9	6
Total Decapoda.....	23	14	18	16	16	13	10
Schizopoda.....	7	6	4	3	3	2	1
Cumacea.....	6	4	4	2	1	2	
Total.....	36	24	26	21	20	17	10

Of the thirty-six Greenland species, six are not yet recorded from outside the Greenland seas, so that out of thirty species, twenty-six, or about eighty-seven per cent., are known upon the eastern coast of North America from the Gulf of St. Lawrence southward; while twenty-four species, or eighty per cent., are known in the European seas. An uncompleted examination of the Amphipoda gives results entirely in harmony with those above derived from the Thoracostraca, so that it is certainly safe to assert that, at least as far as the Malacostraca are concerned, the marine fauna of Greenland is essentially the same as that of the arctic seas of both Europe and America, or, in other words, it is only a part of the great arctic, circumpolar fauna. That the fauna of the Greenland seas should have its closest relations with the fauna of the North American coast proper, rather than with that of Europe, is what might be expected from the geographical position of Greenland and the fact that the waters of the northern part of the North American coast are more arctic in temperature than the waters upon the coast of Europe.

ERRATA.

Page 31, 2d line, for 'Robert,' read 'Richard.'

" 54, for 'Munadopsis,' read 'Munidopsis.'

" 61, 6th line from bottom, for 'Mere,' read 'Meere.'

" 69, 9th line from bottom, for 'Tynside,' read 'Tyneside.'

" 105, 3d line from bottom, insert 'of' before '*M. oculata*.'

" 115, 1st line, for 'nasicoidis,' read 'nasicoides.'

" 120, 16th line, for '*Pseudopleuronectes*,' read '*Pseudopleuronectes*.'

NEW HAVEN, May 1, 1879.

Plate VIII.

Figure 1.—*Cancer borealis* Stimpson; dorsal view of a small male from Casco Bay; nine-tenths natural size. Figures 1a, 1b, terminal portions of the chelipeds of the same specimen, seen from the outer side; natural size.

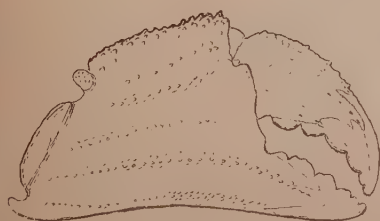






Plate IX.

- Figure 1.—*Geryon quinquedens* Smith; dorsal view of the carapax of a large male (*b*) from off Cape Ann; four-fifths natural size. Figure 1*a*, frontal region of the same specimen, seen from beneath; one and a third times natural size. Figure 1*b*, terminal portions of the chelipeds of the same specimen; enlarged the same amount.
- Figure 2.—The same species; dorsal view of the carapax of a small female (*c*) from off Massachusetts Bay; one and a third times natural size.
- Figure 3.—*Geryon tridens* Kröyer; dorsal view of the carapax of a large male from Christiania Fiord, Norway; two-thirds natural size. Figure 3*a*, frontal region of the same specimen, seen from beneath: one and a third times natural size.
- Figure 4.—*Hippolyte pusiola* Kröyer; tip of the telson of a female 20.5^{mm} long, from the Bay of Fundy, with more than the normal number of terminal spines; enlarged thirty-two diameters.
- Figure 5.—The same species; terminal portion of the telson of a female 16^{mm} long, from Halifax, Nova Scotia, with an abnormal arrangement of aculei and spines, apparently resulting from some injury; enlarged thirty-two diameters.
- Figure 6.—The same species; terminal portion of the telson of a male, 17^{mm} long, from the Bay of Fundy, with less than the normal number of terminal spines; enlarged thirty-two diameters.
- Figure 7.—The same species; terminal portion of the telson of a male, 15^{mm} long, from near Cashe's Ledge, off the coast of Maine, with the normal arrangement of spines; enlarged thirty-two diameters.
- Figure 8.—*Hippolyte Gaimardii* Milne-Edwards; tip of telson of a female, 36^{mm} long, from Halifax, Nova Scotia, with the normal armament of spines; enlarged sixteen diameters.
- Figure 9.—The same species; tip of the telson of a female, 39^{mm} long, from Casco Bay, with an abnormal armament of spines; enlarged thirty-two diameters.

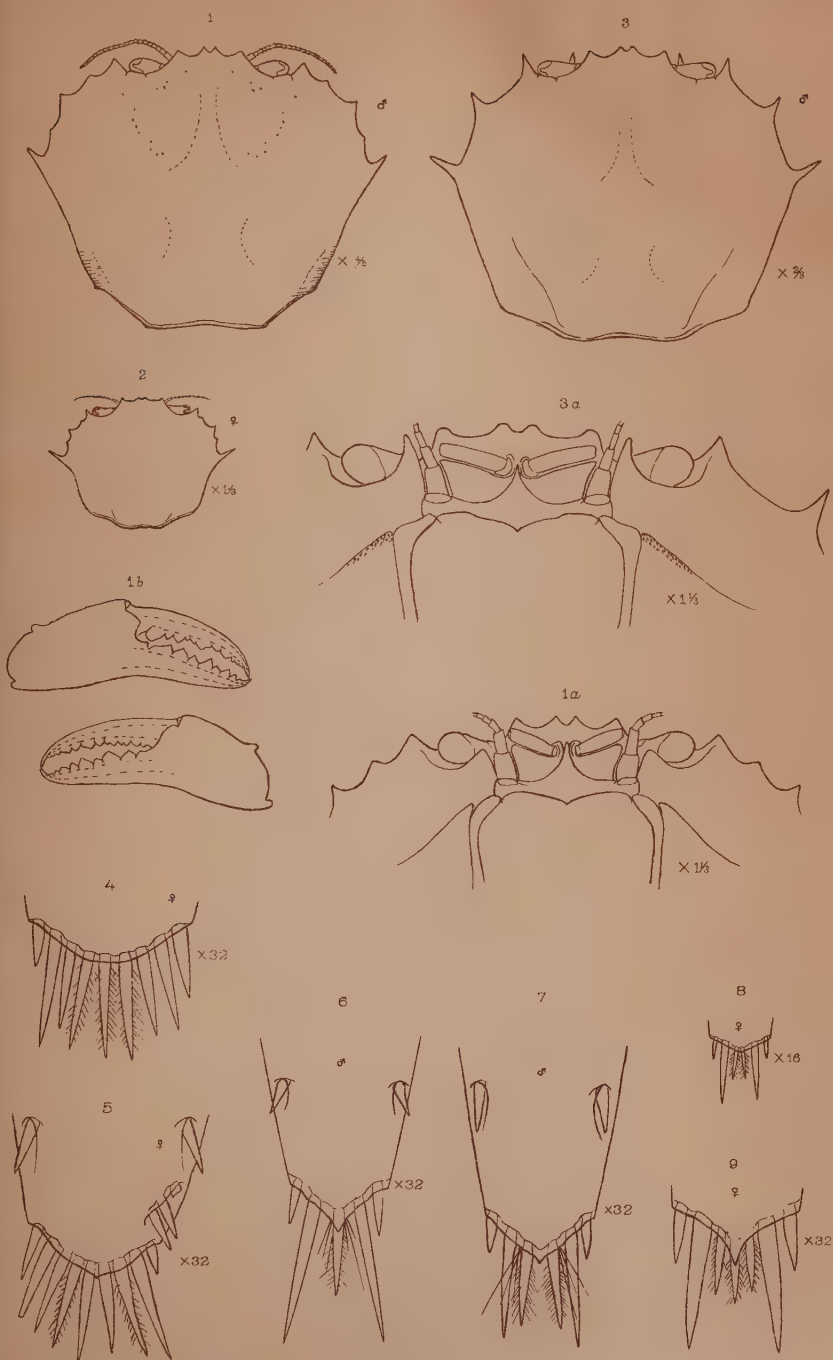




Plate X.

Figure 1.—*Pasiphaë tarda* Kröyer; from the Gulf of Maine; lateral view, three-fourths natural size.

Figure 2.—*Hippolyte Grœnlandica* Miers; female from the Bay of Fundy; lateral view, one and a half times natural size.

Figure 3.—*Hippolyte securifrons* Norman; female from off Massachusetts Bay; lateral view, one and a half times natural size.

Figure 4.—*Axius serratus* Stimpson; dorsal view of the original specimen in the collection of the Peabody Academy of Science, Salem. Figure 4a, lateral view of the right cheliped.

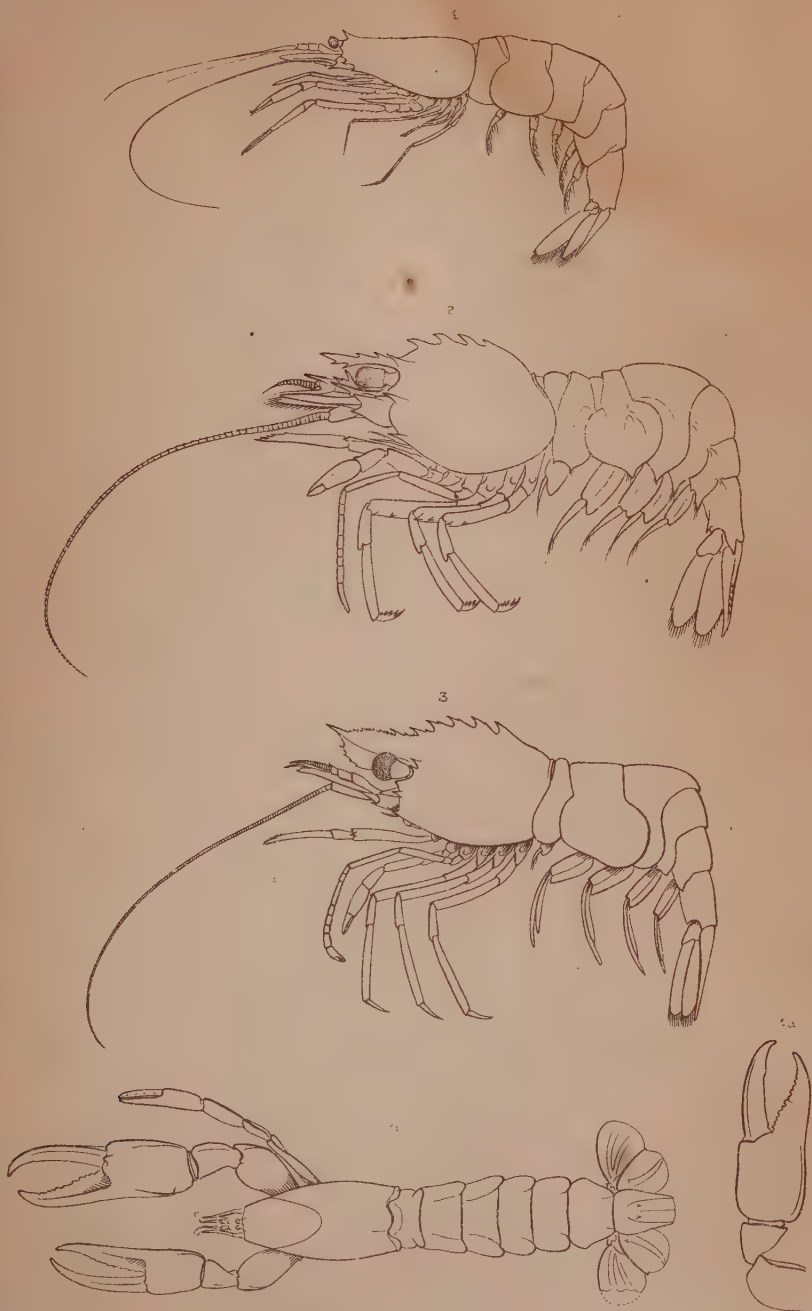




Plate XI.

- Figure 1.—*Hippolyte polaris* Ross; anterior pleopod of the left side of a male, 39.4^{mm} long, from the Gulf of Maine; enlarged twelve diameters.
- Figure 2.—Inner lamella of the left pleopod of the second pair of the same specimen; enlarged the same amount.
- Figure 3.—The same species; anterior pleopod of the left side of a female, 45^{mm} long, from near Cashe's Ledge, off the coast of Maine; enlarged twelve diameters.
- Figure 4.—Inner lamella of the left pleopod of the second pair of the same specimen; enlarged the same amount.
- Figure 5.—*Sabinea septemcarinata* Ross; dorsal view of the carapax of a female from off Massachusetts Bay; enlarged two diameters.
- Figure 6.—*Sabinea Sarsii* Smith; dorsal view of the carapax of a female, 62^{mm} long, from the Lofoten Islands, Norway; enlarged two diameters. Figure 6a, lateral view of the same. Figure 6b, dorsal view of the extremity of the abdomen of the same specimen, showing the right uropod and the telson; enlarged three diameters. Figure 6c, tip of the telson of the same specimen; enlarged twelve diameters.
- Figure 7.—The same species; tip of the telson of a female, 36^{mm} long, from the Gulf of Maine; enlarged twelve diameters.
- Figure 8.—The same species; tip of the telson of a young specimen, only 16^{mm} long, from St. George's Bank; enlarged twenty-four diameters.
- Figure 9.—*Sabinea septemcarinata* Ross; dorsal view of the extremity of the abdomen of a female from off Massachusetts Bay, showing the appendages of the right side of the sixth segment and the telson; enlarged three diameters.
- Figure 10.—The same species; tip of the telson of an adult male, 40^{mm} long, from off Massachusetts Bay, with what appears to be the normal arrangement of the terminal spines; enlarged twelve diameters.
- Figure 11.—The same species; tip of the telson of an adult female, about 60^{mm} long, from off Massachusetts Bay, with the normal armament; enlarged twelve diameters.
- Figures 12 and 13.—The same species; tips of the telsons of two adult females from off Massachusetts Bay, with an apparently abnormal arrangement of terminal spines—in the second case evidently the result of injury; enlarged twelve diameters.

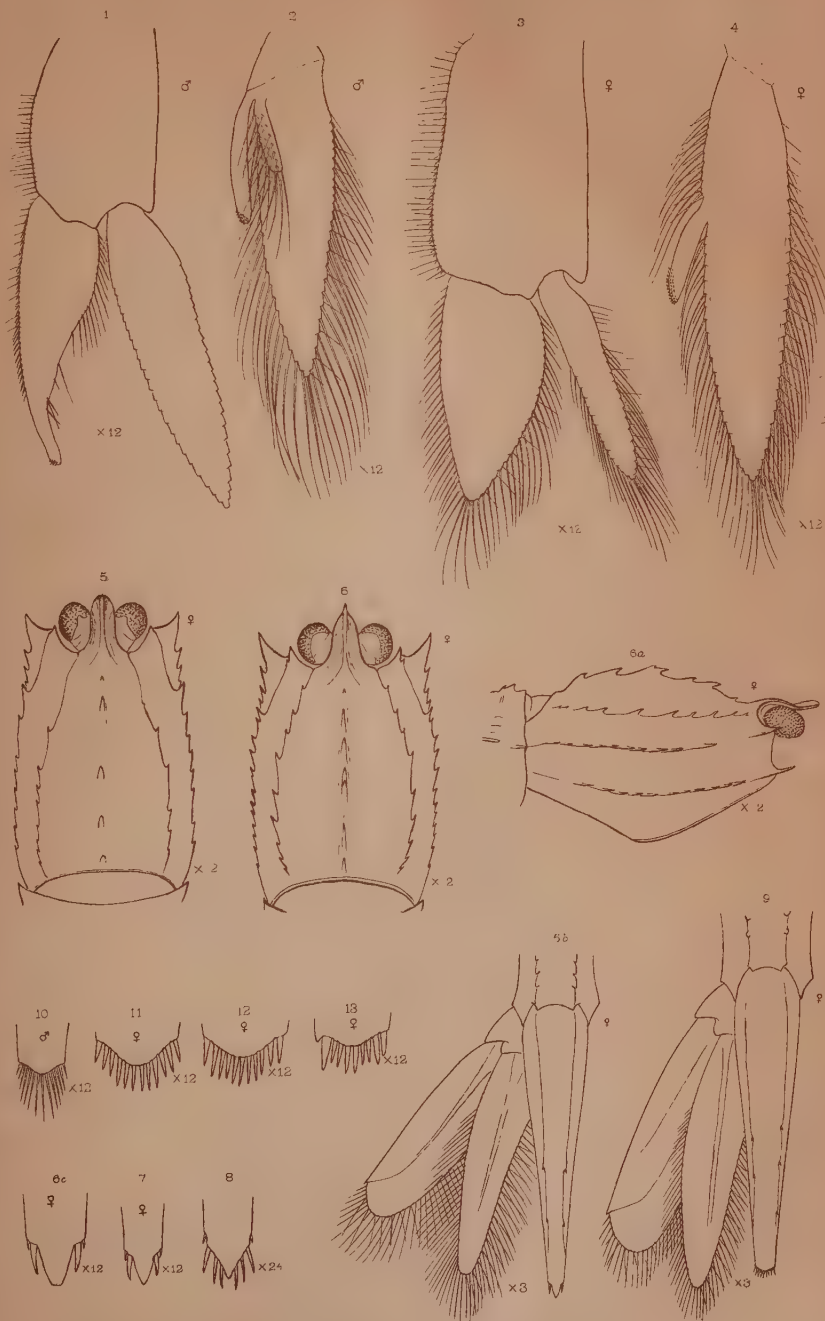


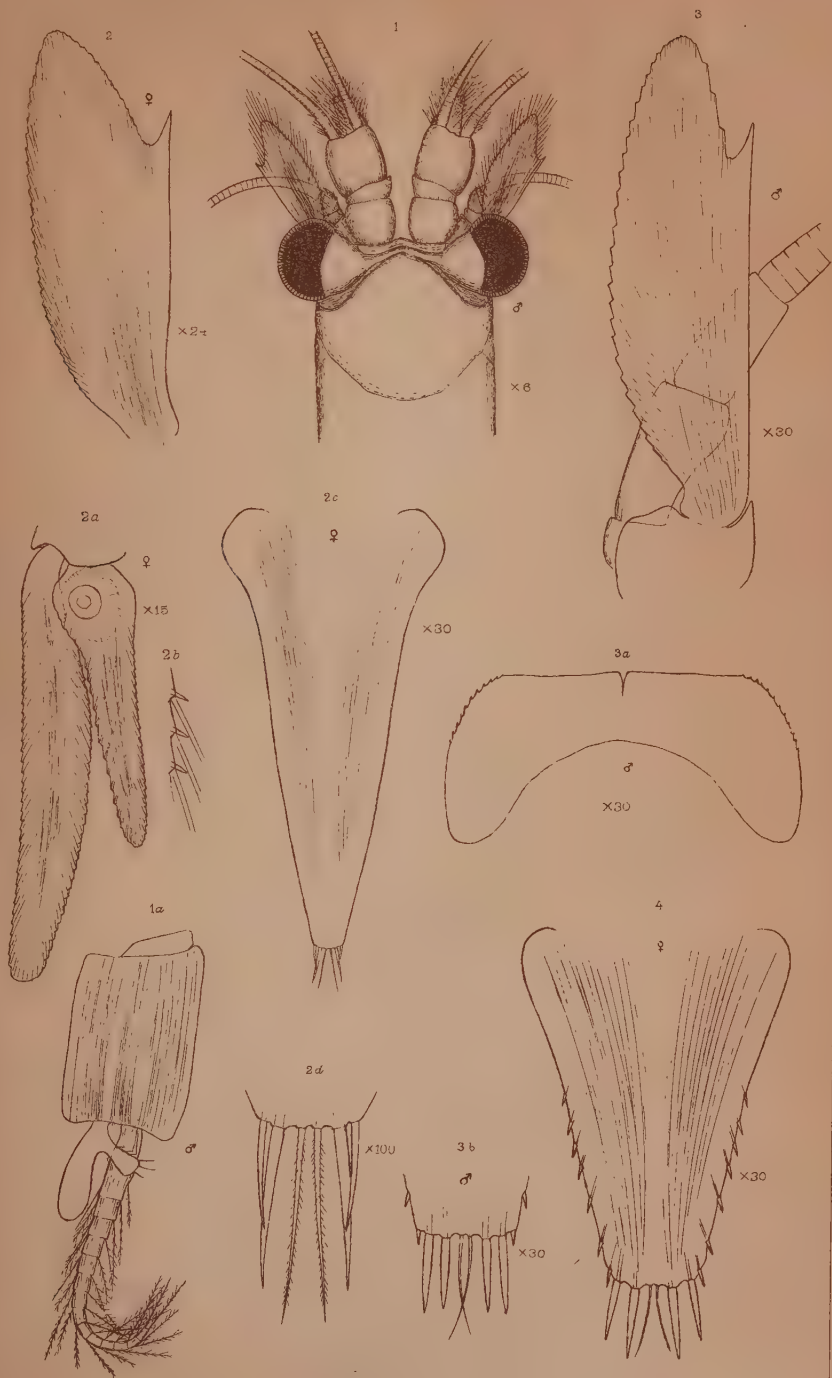
Plate XII.

Figure 1.—*Meterythrops robusta* Smith; dorsal view of the front part of a male, 19^{mm} long, from the Gulf of St. Lawrence; enlarged six diameters. Figure 1*a*, one of the anterior pleopods of the same specimen; enlarged twelve diameters.

Figure 2.—The same species; antennal scale of a female, 16·5^{mm} long, from the Gulf of St. Lawrence; enlarged twenty-four diameters; the marginal plumose setæ omitted. Figure 2*a*, dorsal view of the lamellæ of the uropod of the left side of the same specimen; enlarged fifteen diameters. Figure 2*b*, a part of the inner margin of the inner lamella, more highly magnified to show the marginal spines and the bases of the plumose setæ. Figure 2*c*, telson of the same specimen; enlarged thirty diameters. Figure 2*d*, tip of the same telson, more magnified.

Figure 3.—*Pseudomma truncatum* Smith; dorsal view of the antenna of an adult male; enlarged thirty diameters. Figure 3*a*, outline of the opthalmic segment of the same specimen; enlarged thirty diameters. Figure 3*b*, tip of the telson of the same specimen; enlarged thirty diameters; the cilia of the median setæ omitted.

Figure 4.—The same species; telson of an adult female; enlarged thirty diameters; the cilia of the median terminal setæ omitted.



(From the Report of Progress of the Geological Survey of Canada, 1878-79)

NOTES ON CRUSTACEA

COLLECTED BY DR. G. M. DAWSON

AT

VANCOUVER AND THE QUEEN CHARLOTTE ISLANDS.

BY S. I. SMITH.

APPENDIX D.

NOTES ON CRUSTACEA

COLLECTED BY DR. G. M. DAWSON

AT

VANCOUVER AND THE QUEEN CHARLOTTE ISLANDS,

By S. I. SMITH.

BRACHYURA.

Heterograpsus nudus Stimpson.

Pseudograpsus nudus Dana, Proceedings Acad. Nat. Sci., Philadelphia, 1851, p. 249 (3); United States Exploring Expedition, Crust., p. 335, pl. 20, fig. 7, 1852.—Stimpson, Journal Boston Soc. Nat. Hist., vi., p. 469 (29), 1857.

Cyclograpsus marmoratus White, List of Crust. British Museum, p. 41, 1847 (no description).

Heterograpsus marmoratus Milne-Edwards, Annales Sci. Nat., III., xx., p. 193 (159), 1853.

Heterograpsus nudus Stimpson, Proceedings Acad. Nat. Sci., Philadelphia, 1858, p. 104 (50).

A fine male specimen from near Victoria, Vancouver Island. Sitka is given by White as the locality for one of the specimens in the British Museum. It is abundant upon the Oregon and California coast.

Fabia subquadrata Dana.

Two specimens from the Queen Charlotte Islands, shore; and one from "Houston Stewart Channel, Q.C.I., June, 1878, inhabiting cavity of large mussel."

Cancer magister Dana.

Cancer irroratus Randall, Jour. Acad. Nat. Sci., Philadelphia, viii., p. 116, 1839 (not of Say).

Cancer magister Dana, United States Exploring Expedition, Crust., p. 151, pl. 7, fig. 1, 1852.—Stimpson, Jour. Boston Soc. Nat. Hist., vi., p. 458 (18), 1857.

Metacarcinus magister A. Milne-Edwards, Annales Sci. Nat., IV., xviii., p. 33, 1862; op. cit., V., i., p. 67, 1864; Nouvelle Archives Mus. Hist. Nat., Paris, i., p. 201, pl. 19, fig. 1, 1865.

A large carapax from the Queen Charlotte Islands.

Cancer productus Randall.

Randall, Jour. Acad. Nat. Sci., Philadelphia, viii., p. 116, 1839.—Dana, United States Exploring Expedition, Crust., p. 156, pl. 7, fig. 3.—Stimpson, Jour. Bost. Soc. Nat. Hist., vi., p. 461 (21), 1857.

Cancer perlatus Stimpson, Proceedings California Acad. Nat. Sci., i., p. 88, 1856.

Virago Sound, 15 to 8 fath.; mouth of Cumsheewa Harbour, 20 fath.; and shallow dredging; all from the Queen Charlotte Islands.

Cancer antennarius Stimpson.

Stimpson, Proceedings California Acad. Sci., i., p. 88, 1856; Jour. Bos. Soc. Nat. Hist., vi., p. 442 (22), pl. 18, 1857.

? *Platycarcinus recurvidens* Bate, in J. K. Lord, Naturalist in Vancouver Island, ii., p. 269, 1866.

Small alcoholic specimens from Virago Sound, 15 to 8 fath., and 20 fath., mouth of Cumsheewa Harbour, Q.C.I. A dry carapax from the same group of islands (no special locality given) is 83 mm. long and 133 broad.

Trichocarcinus Oregonensis Miers.

Tricocera Oregonensis Dana, United States Exploring Expedition, Crust., p. 299, pl. 18, fig. 5, 1852.

Trichocarcinus Oregonensis Miers, Proceedings Zool. Soc. London, 1879, p. 34 (*Tricocera* De Haan, 1833, preoccupied).

A young specimen from Vancouver Island, and the carapax and chelipeds of a larger specimen from the Queen Charlotte Islands. These specimens agree with Dana's description and figure, except that the teeth of the postero-lateral margin are more indistinct than shown in his figure, some of them being nearly or quite obsolete. In all the larger specimens which I have examined, the dorsal surface of the carapax is rougher and the areolets more protuberant than in small specimens, and in very small specimens the carapax is nearly smooth and regularly convex.

A small specimen, dredged by Mr. J. Richardson in the Gulf of Georgia in 1875, and referred to by Mr. Whiteaves as *Trichocera Oregonensis*? on my authority (*Canadian Naturalist*, Vol. viii., No. 8, 1878), appears to represent a distinct species. I have seen another and much larger specimen of the same form from Washington Territory, collected by J. G. Swan (Smithsonian Institution). In this species the antero-lateral margin of the carapax is strongly upturned,

and its teeth are broad and in contact at their bases. The frontal and hepatic regions and the anterior part of the branchial are smooth and flat or concave, but there are three very high, wart-like prominences on the gastric region, of which the two anterior are larger and mark the protogastric lobes, while the smaller is in the median line and behind them; there are similar, but posteriorly less distinctly circumscribed protuberances on the posterior part of the branchial region; and the tops of all the protuberances are ornamented with smooth mammillary granules, which are large anteriorly but gradually lose the mammillary character in the rough and granular posterior regions of the carapax, which differ much from the anterior and middle regions, which are very smooth, except on the flattened summits of the gastric protuberances just described.

Telmessus serratus White.

White, *Annals Mag. Nat. Hist.*, xvii., p. 497, 1846; *Voyage of Samarang*, Crust., p. 14, pl. 3, 1848.—Dana, *United States Exploring Expedition*, p. 303, pl. 18, fig. 8, 1852.

There are three specimens of *Telmessus* from the Queen Charlotte Islands: two small males, in alcohol, from shallow dredging, and a dry and broken female much larger than the males. The female agrees very well with White's figure and is about the same size as White's specimen, though of the opposite sex. The larger of the two males agrees with Dana's figure and description, except that the median teeth of the front are not quite as acute and prominent, projecting only very little beyond the lateral. The tooth forming the lateral angle of the carapax is much more prominent than in the female. The smaller male differs from the larger in having the antero-lateral margins of the carapax nearly parallel, and the tooth forming the lateral angle relatively even much more prominent than in the larger male. These differences are shown in the following measurements of the carapaces of the three specimens:—

	♂	♂	♀
Length, including frontal spines.....	6.6 mm	20.3	66.5
Breadth in front of lateral teeth.....	5.7	19.4	66.0
Breadth, including lateral teeth.....	8.9	25.3	82.2

The differences are apparently due to the age of the specimens, and I think there can be little doubt that White's specimen and Dana's were of the same species. Whether the *T. cheiragonus* described by Tilesius and by Brandt, and *T. acutidens* Miers (ex Stimpson), are also of the same species, I am uncertain. The synonymy in this genus is still in great confusion, and the relations of the different forms can be made out satisfactorily only by careful examination of a large series of specimens.

Oregonia gracilis Dana.

Oregonia gracilis Dana, United States Exploring Expedition, Crust., p. 106, pl. 3, fig. 2, 1852 (♂).

Oregonia hirta Dana, *ibid.*, p. 107, pl. 3, fig. 3, 1852 (♀).

? *Oregonia longimana* Bate, Proceedings Zoological Society London, 1864, p. 663, 1865; in J. K. Lord, Naturalist in Vancouver Island, ii., p. 267, 1866.

Virago Sound, Q.C.I., 15 to 8 fath., also Vancouver Island.

The series of specimens is sufficient to show that the two forms described by Dana are sexual and belong to one species, the *gracilis* being based on the adult male and the *hirta* on the two forms of the female. In the characters of the rostral spines and the rest of the carapax, all the larger males before me agree with the description and figures of *gracilis*, while in the same characters the females agree with *hirta*, and the smaller males are more or less intermediate between the two forms. But among the females themselves there are two forms: all the adult and fertile specimens having the abdomen very broad and nearly orbicular, while in other specimens (most of them small, but some of them as large as the smaller of those with orbicular abdomens) the abdomen is much narrower and elliptical, as shown in Dana's fig. 3 b. The smaller of these latter females are, perhaps, merely immature individuals, but the larger are apparently truly dimorphic, sterile females, such as are found in many genera of Brachyura, and here, as in most similar cases, the larger of the sterile individuals show considerable approach to the male in the form of the carapax, etc.

In the largest male before me the merus of the chelipeds reaches very nearly or quite to the tips of the rostrum, and, in this respect, agrees with Bate's *O. longimana*, though the chelipeds are not nearly twice as long as the carapax, if the rostrum is, as it is usually, included in the length. Bate makes no allusion to the size of his specimen, and describes it so imperfectly that it is not easy to determine its affinities with certainty.*

* It may be well to remark here that there had apparently been an admixture of specimens from some region or regions far south of Vancouver Island, in the collection which served as the basis of Bate's chapter on "Vancouver Island Crabs" in the work above referred to, and that this fact also adds to the difficulty of determining the species there described. Bate himself remarked upon the mingling of northern and southern forms in the collection, but he does not seem to have suspected any mistake in regard to the localities from which the specimens came. I am aware that many tropical and subtropical marine species extend far north along the Pacific American coast, but it is scarcely conceivable that such an assemblage of species as Bate's list indicates should exist in any one faunal region. The list contains not only tropical Pacific American species but also Central and South Pacific, and even tropical Atlantic species. Some of the incongruities may, however, be due to wrong identifications, as in the case of the *Clibanarius* about to be mentioned; but, making all reasonably supposable allowance for mistakes of this kind, there is still sufficient evidence of a mixture of specimens from different faunæ, to throw doubt upon the authenticity of the supposed habitats of many of the new species in Mr. Lord's collection. The existence in the region of Vancouver Island of any of the following species (all of which are enumerated among the Decapoda in Bate's list) is, at least, very doubtful:—*Eriphia gonagra*, "*Panopeus*" *crenatus*, *Xantho dispar*, *Ocypode Groullei*, *Grapsus lividus*, *Hemigrapsus* "*edentatus*," *Gelasimus annulipes*, *Porcellana Edwardsii*, *Eupagurus perlatus*,

Pugettia gracilis Dana.

Queen Charlotte Islands, shore; and shallow dredging, Port Simpson to north end of Vancouver Island.

Scyra acutifrons Dana.

Two males from near Victoria, Vancouver Island. Another male specimen agreeing well with these was collected at the same locality by Mr. R. Middleton in 1875, and is referred to by Mr. Whiteaves, on my authority, as "*Scyra*, sp. undt." (*Canadian Naturalist*, Vol. viii., No. 8, 1878.) All these specimens are much larger than the ones described by Dana, and differ much from his description and figures. The specimen collected by Mr. Middleton differed so much that I at first supposed it must represent a new species, but the specimens collected by Dr. Dawson show a nearer approach to Dana's figures, and I now think there is little doubt that Dana's description and figures were based on females and young males, and that the specimens before me are the fully adult males of the same species.

In the specimens before me, the lamelliform rostrum is very much expanded laterally, so that it is as wide, or even considerably wider than, the width of the front between the preocular spines, and the lobes are much less divergent anteriorly than shown in Dana's figure. The protuberance upon each branchial region is elongated and excessively developed, and posteriorly it projects so much as to overhang the lateral margin of the carapax. The anterior cardiac protuberance is tubercular and obtuse and fully as high as the branchial protuberances, but separated from them and from the large gastric protuberance by a broad and deep depression; the posterior cardiac protuberance is small, but conical and conspicuous. The whole gastric region is protuberant, and separated from the branchial region, on each side, by a deep and narrow cervical groove. The posterior gastric elevation is large and obtusely tubercular, while the anterior is small and conical. The chelipeds are proportionably much larger every way than in Dana's specimens, and the lamelliform crest on the propodus is much broader. The differences in the chelipeds, and partially also those in the carapax, are shown by the following measurements of the specimens collected by Dr. Dawson:—

"*Cenobites*" *Diogenes*. *Olibanarius lineatus* (Milne-Edwards) is also given, but there is now plain evidence of a mistake in the identification, for Miers (Proceedings Zoological Society, London, 1877, p. 658, pl. 66, fig. 4) has described and figured a species, as *Olibanarius Lordi*, said to have been collected at the same locality as Bate's *C. lineatus*, and presented to the British Museum by Mr. Lord, and Miers states that the specimen was labelled *Olibanarius lineatus*, but that it is certainly not the species described under that name by Milne-Edwards and figured by Dana.

Length of carapax, including rostrum.....	36·8 mm	39·0
Greatest breadth between margins.....	24·7	26·8
“ “ “ branchial protuberances	27·3	29·5
Length of rostrum from base of præocular spine..	9·0	10·3
Greatest breadth of rostrum.....	7·7	9·0
Length of merus in chelipeds.....	22·0	28·5
Length of propodus.....	31·0	37·0
Length of dactylus.....	15·0	16·5
Breadth of dactylus.....	10·5	12·5

ANOMURA.

Hapalogaster inermis Stimpson.

Stimpson, Annals Lyceum Nat. Hist. New York, vii., p. 243 (115), 1860.

I refer to this species, with some doubt, a single female from the shores of the Queen Charlotte Islands. The chelipeds are not described by Stimpson, but in the specimen before me they are very unequal, the right being twice as stout as the left, very much less setose, and the excavated fingers are entirely without horny tips.

Eupagurus granosimanus Stimpson.

Stimpson, Annals Lyceum Nat. Hist. New York, vii., p. 90 (44), 1859.

Several dry specimens, most of them very small, from near Victoria, V.I. I think it not improbable that this species will prove to be synonymous with *E. Middendorffii* Brandt. Brandt's species was described and figured from a specimen considerably larger than the specimens examined by Stimpson or those before me, and it very likely is only the fully adult form of Stimpson's species.

Eupagurus tenuimanus Stimpson (ex Dana).

One specimen from shallow dredgings, Port Simpson to the north end of Vancouver Island. The propodus of the larger cheliped is fully as broad as in Dana's specimens, but the inner edge is less sharply dentate and the outer edge less strongly curved. There is no doubt of its identity with Dana's species, however.

There are several small specimens of *Eupagurus* from 15 to 8 fath., Virago Sound, 20 fath., mouth of Cumshewa Harbour, and from Houston Stewart Channel, Q.C.I., which are distinct from either of the above species, but they appear to be immature and are not easily determined.

Paguristes turgidus Stimpson.

Eupagurus turgidus Stimpson, Proceedings Boston Soc. Nat. Hist., vi., p. 86, 1857.

Clibanarius turgidus Stimpson, Journal Boston Soc. Nat. Hist., vi., p. 484 (44), pl. 21, fig. 1, 1857.

Paguristes turgidus Stimpson, Proceedings Acad. Nat. Sci., Philadelphia, 1858, p. 236 (74), 1859; Annals Lyceum Nat. Hist., New York, vii., p. 86 (40), 1859.

Not in Dr. Dawson's collection, but a large male was dredged in the Gulf of Georgia by Mr. J. Richardson in 1875.

MACRURA.

Gebia Pugettensis Dana.

A male 85 ^{mm.} long, shore, Queen Charlotte Islands.

Crangon vulgaris J. C. Fabricius ex Linné.

Crangon nigricauda Stimpson.

Crangon nigromaculata Lockington.

Crangon Alaskensis Lockington.

A single dry and broken specimen from Vancouver Island.

Nectocrangon lar Brandt (ex Owen).

Two males and three females from Vancouver Island.

The specimens are all dry and in rather bad condition for a careful comparison, but they all differ considerably from any Atlantic specimens which I have seen. In the specimens from Vancouver, the rostrum and the spines of the dorsal carina of the carapax are longer and more slender than in specimens from off Nova Scotia and from the Gulf of St. Lawrence. In the Vancouver specimens, the dorsal carina on the third, fourth and fifth segments of the abdomen is broad and rounded, or flattened, and scarcely reaches the posterior edges of the segments, and the two carinae upon the sixth segment are rounded and fade out in the same way before reaching the posterior extremity of the segment; while in the Atlantic specimens referred to, the carina upon the third, fourth and fifth segments is acute, and on the fifth segment projects from the posterior margin in a more or less conspicuous triangular tooth, and the carinae on the sixth segment are acute and continue to or a little over the posterior extremity of the segment. These differences may possibly indicate distinct geographical species.

Paracrangon echinatus Dana.

Vancouver Island.

Hippolyte Gaimardii Milne-Edwards.

Hippolyte Gaimardii Milne-Edwards, Hist. nat. des Crust., ii., p. 378, 1837.

Hippolyte pandaliformis Bell, History of British Stalk-eyed Crustacea, p. 294.
[1850 ?]

Hippolyte Belcheri Bell, in Belcher, Last of the Arctic Voyages in Search of Sir John Franklin, vol. ii., p. 402, pl. 34, fig. 1, 1855.

A single dry female specimen from Vancouver Island appears unquestionably of this species. It is about 33^{mm} long; the carapax, including the rostrum, 13·8^{mm}; the rostrum, 7·3. The dorsal carina is armed with six teeth, of which three are on the rostrum, and there are three teeth in the lower edge of the rostrum.

Hippolyte spinus White.

Cancer spinus Sowerby, British Miscellany, p. 47, pl. 23, 1805.

Alpheus spinus Leach, "Edinburgh Encyclopedia, vii., p. 431, 1813-14," (Miers), American edit., vii., p. 271; Transactions Linnean Soc. London, xi., p. 347, 1815.

Hippolyte Sowerbaei Leach, Malacostraca Podophthalmata Britanniae, pl. 39, 1817.

Hippolyte spinus White, List Crust. British Museum, p. 76, 1847.—Bell, History of British Crustacea, p. 284 [1847?].

Hippolyte spina Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, xii., p. 34 (103), 1860; Annals Lyceum Nat. Hist. New York, x., p. 126, 1871.

There are seven dry specimens from Vancouver Island, and two in alcohol from shallow dredging, Queen Charlotte Islands, which agree well with Atlantic specimens of this species.

Hippolyte Phippsii Kröyer.

Hippolyte Phippsii Kröyer, Naturhistorisk Tidsskrift, iii., p. 575, 1841 (♂).

Hippolyte turgida Kröyer, *ibid.*, p. 575, 1841 (♀).

Hippolyte vibrans Stimpson, Annals Lyceum Nat. Hist. New York, x., p. 125, 1871 (♂, *var.*).

Hippolyte Ochotensis Brandt, Middendorff's Sibirische Reise, ii., p. 120, pl. 5, fig. 17, 1849 (♀).

A female from 15 to 8 fath., Virago Sound, Q.C.I. Length, 32^{mm}; length of carapax, including rostrum, 11·6; rostrum, 5·2. The dorsal carina of the carapax and rostrum is armed with eleven teeth, of which the three posterior are the larger, situated near the middle of the carapax and separated considerably from the one next in front, which is just over the base of the rostrum; the remaining teeth are successively nearer to each other toward the tip, which is itself tridentate. There are in addition four teeth on the oblique anterior part of the inferior edge of the rostrum. The dentition of the carapax and rostrum is thus seen to approach pretty closely to Brandt's *H. Ochotensis*, and yet the specimen appears to be unquestionably specifically identical with the well-known Atlantic species, so that I have little doubt that Brandt's species is only a variety of the female of *H. Phippsii*.

Hippolyte brevirostris Dana.

Dana, United States Exploring Expedition, Crust., p. 566, pl. 36, fig. 5, 1852
(given as *H. curvirostris* on plate).

A dry female specimen about 24^{mm}. long, from Vancouver Island, agrees well with Dana's figure and description.

Hippolyte Grænlandica Miers.

Astacus Grænlandicus J. C. Fabricius, Systema Entomologiæ, p. 416, 1775;
Entomologia systematica, ii., p. 484, 1793.

Cancer aculeatus O. Fabricius, Fauna Grænlandica, p. 239, 1780.

Alpheus aculeatus Sabine, in Supplement to Appendix of Parry's (first)
Voyage, p. cccxxviii., pl. 2, figs. 5-8, 1824.

Hippolyte aculeata J. C. Ross, in John Ross, Appendix to Narrative of a
Second Voyage in Search of the North-west Passage, p. lxxxiii.,
1835.

Hippolyte armata Owen, Voyage of the Blossom, p. 88, pl. 27, fig. 2, 1839 (♀).

Hippolyte cornuta Owen, op. cit., p. 89, pl. 28, fig. 2, 1839 (♂).

Hippolyte Grænlandica Miers, Annals and Magazine Nat. Hist., IV., xx., p.
62 (12), 1877.

A female, 44^{mm}. long, from shallow dredging, Queen Charlotte Islands.

Pandalus Danæ Stimpson.

Stimpson, Proceedings Boston Soc. Nat. Hist., vi., p. 87, 1857; Journal
Boston Soc. Nat. Hist., vi., p. 502 (62), pl. 21, figs. 6-7, 1857.

Several small dry specimens from Vancouver Island, and an alcoholic specimen from shallow dredgings, Queen Charlotte Islands. The last specimen is 74^{mm}. long; the carapax including rostrum, 33^{mm}.; rostrum, 17.5^{mm}.; there are ten teeth in the dorsal crest, half being on the rostrum and half upon the carapax, and in addition there are three at the tip and five beneath the rostrum.

In general appearance, and particularly in the form and dentition of the carapax and rostrum, this species approaches very near to *P. platyceros* Brandt (Middendorff's Sibirische Reise, ii., p. 123, pl. 5, fig. 20, 1851). But, according to Brandt's description, the carapax of the *platyceros* is clothed with short hairs, while in the *Danæ* the carapax and abdomen are smooth and entirely naked.

Pandalus pubescentulus Dana.

An alcoholic specimen from "shallow dredging, Port Simpson to north end of Vancouver Island." The specimen is 49^{mm}. long; the carapax including rostrum, 25; rostrum, 14. There are fourteen teeth in the dorsal crest, five on the carapax and nine on the rostrum; the extremity of the rostrum is unarmed above except at the tip, which is

bidentate; beneath it is armed with eight teeth, which extend to the tip.

CUMACEA.

Diastylopsis, gen. nov.

The species for which this genus is proposed is very closely allied to *Diastylis* in the structure of the appendages of the cephaloperæon and in the structure of the pleon, but it differs from *Diastylis*, and, as far as I know, from the heretofore described genera of Cumacea, in the consolidation and great expansion of the tergal and epimeral portions of the third and fourth free segments of the peræon, which forms an arched shield-like plate nearly half as large as the carapax. The basal segments of the second pair of gnathopods (third maxillipeds) are more expanded distally and form a much more complete oral operculum than in *Diastylis*. The cephaloperæon, also, is much more elongated and more compressed laterally than in any described species of *Diastylis*.

Diastylopsis Dawsoni, sp. nov.

Female.—The cephaloperæon is considerably longer than the pleon, compressed laterally so that the breadth is little more than a fourth of the length, and the part made up of the free segments is fully as wide and as high as the carapax. The carapax is more than twice as long as high and smoothly rounded above, though the dorsum is compressed somewhat anteriorly. The eye is obscure or wanting, and the anterior lobes of the carapax extend far in front of the ophthalmic lobe and form a prominent and acute rostrum. There is a deep antennal sinus (much deeper than in the species of *Diastylis*) in the anterior margin below the rostrum and bounded inferiorly by the prominent dentiform antero-lateral angle, back of which the lateral margin is dentated for a short distance. The entire surface of the carapax, as well as the dorsal surface of the free segments of the peræon, is perfectly smooth, naked and highly polished, but there are four nearly equidistant, faintly indicated transverse lines crossing the anterior half of the carapax and evidently marking the areolation so conspicuous in some species of *Diastylis*. The first and second of the five free segments of the peræon are short and nearly or quite covered each side by the third segment, which is itself short above but greatly expanded each side into a large plate a third as long as the carapax; the dorsal part of the fourth segment is greatly elongated, and lies between and above the lateral prolongations of the third segment; and the tergal and epimeral portions of these two segments are anchylosed or closely united together, so that the U-shaped suture between them is only

faintly indicated. The fifth segment is small, and nearly covered each side by the lateral expansions of the fourth. There are two slender submedian spines upon the ventral side of the fifth segment, and there is a similar single median spine on the first segment of the pleon.

The antennulæ are short, the peduncle reaching scarcely beyond the rostrum; the first segment is stout and about as long as the second and third together, the second is short and stout, and the third, or ultimate, about half the diameter of the second but longer than it; the major flagellum is slender and about half as long as the peduncle; the minor flagellum is little longer than the first segment of the major, and is apparently triarticulate. The rudimentary antenna is scarcely longer than the first segment of the antennula, but has the penultimate segment elongated to about four times its diameter, while all the other segments are very short.

The first gnathopods (second maxillipeds) are nearly as in *Diastylis*, but are very long and slender, and the basal segments are but little stouter than the terminal. The second gnathopods reach a little beyond the tip of the rostrum: the basal segment in each reaches to the antero-lateral angle of the carapax and is very much expanded distally, so that the two together completely close the space between the lateral margins of the carapax; the inner angle of the distal end projects in a very prominent and acute tooth, and the inner edge is margined with short plumose setæ, but the outer surface is smooth and naked like the carapax; the ischium is very short and fully twice as broad as long; the merus is about twice as long as the ischium, not more than half as broad, and bears on the middle of its outer margin a very long plumose seta; the three distal segments are very slender, subequal in length, and each is considerably longer than the merus. The tip of the flagellum of the exognath reaches slightly beyond the middle of the basis of the endopod itself.

The first peraeopods are slender and scarcely as long as the second gnathopods, the tip of the carpus not quite reaching the distal end of the basis of the gnathopod; the ischium is scarcely longer than broad, the merus twice as long as the ischium, and the three distal segments subequal in length and each a little longer than the merus. The tip of the flagellum of the exopod does not reach the extremity of the basis of the endopod. The second peraeopods reach but little beyond the middle of the basis of the first pair, and the exopod is about as long as the endopod. The sternum of the third free segment of the peraeon is broad and greatly elongated to correspond with the lateral portions of the segment, so that the two anterior pairs of peraeopods are separated by a considerable space from the succeeding pairs. The

third, fourth and fifth pairs of pereopods are short and as in the species of *Diastylis*, except that the coxal segments of the third pair are very broad, about four times as broad as high, and closely fitted to the corresponding segment of the pereon.

The pleon is cylindrical and slender throughout, very much narrower than the cephalopereon, and the segments increase slightly and regularly from the first to the sixth. The telson is shorter than the sixth segment, swollen for the proximal half its length, then suddenly narrowed into a slender terminal portion which is armed either side with about five or six very slender spiniform setæ, and at the tip with two styliform setæ nearly half as long as the telson itself. The peduncles of the uropods are slender, not quite twice as long as the telson and armed along the distal half of the inner margin with approximately ten very long setæ. The inner ramus is narrow, about half as long as the peduncle, composed of three segments, armed along the inner edge with approximately twelve slender spines, at the tip with a larger spine, and along the outer edge with a few setæ. The outer ramus is a little longer than the inner, slender, and armed along the outer edge and at the tip with setiform spinules. The telson and uropods are more or less imperfect in all the specimens examined, and do not admit of very exact description.

All the *males* examined are immature and of about the same size as the females. They differ from the females, as in the species of *Diastylis*, in having rudimentary exopods on the third and fourth pereopods and in having rudimentary appendages upon the first and second segments of the pleon. The specimens examined show scarcely any differences in the telson and uropods, but these differences would probably be developed in more mature individuals.

A female gives the following measurements:—

Length from rostrum to tip of telson.....	12.2mm.
Length of cephalopereon along dorsum.....	6.7
Length of carapax along dorsum.....	4.2
Greatest height of carapax.....	2.0
Greatest breadth of carapax.....	1.8
Length of 3rd and 4th free segments of pereon along dorsum.....	1.8
Length of pleon to tip of telson.....	5.6

The few specimens of this very interesting and pretty species were all from 111 fath., Dixon Entrance, Q.C.I. It is interesting to notice that it was associated with *Synidotea nodulosa*, a species before known only from the Atlantic.

ON THE SPECIES OF PINNIXA INHABITING THE NEW ENGLAND
COAST, WITH REMARKS ON THEIR EARLY STAGES. BY S. I. SMITH.

IN the Report of the U. S. Commissioner of Fish and Fisheries for 1871-2, I have figured a species of *Pinnixa* and recorded its occurrence in Vineyard and Long Island Sounds, but referred it incorrectly to *P. cylindrica* (Say sp.) At that time I had examined only three specimens, and all of them were of the species figured. In 1874 and 1875 additional specimens of *Pinnixa* were collected by Fish Commission parties in Fisher's Island Sound, Vineyard Sound, and Buzzard's Bay, but I did not examine them carefully, supposing the specimens to be of the same species as those previously examined. During these seasons, however, I had some opportunities for studying the early stages of the genus.

In 1874 zoeæ of *Pinnixa* were obtained in abundance from the eggs, but I was not able to rear them to later stages. In 1875 zoeæ were again obtained from the eggs and many zoeæ in later stages were taken at the surface. Among those obtained at the surface there were two forms which at first sight looked like two stages of the same species, but on closer examination, they both appeared, judging from the advanced condition of the cephalothoracic and abdominal legs, to be in the last zoea-stage. The larger and much the more abundant of these two forms, the one designated in my notes as the "long-spined zoea," agrees with the zoea of *Pinnixa*, from Newport, Rhode Island, figured by Mr. Faxon (Bull. Mus. Comp. Zool., vol. v, plate 4, figs. 5-15, 1879). The other form, designated in my notes as the "short-spined zoea," is considerably smaller and has very much shorter dorsal and rostral spines, even proportionally shorter than in the first stage of the zoea of *Pinnixa chaetopterana* figured by Mr. Faxon (plate 4, fig. 1), so that the distance from the tip of the dorsal to the tip of the rostral spine is only about half as great as in the long-spined form. Except in these characters I was unable to find any differences whatever and, though then aware of the occurrence of one species only on the New England coast, I supposed that the forms represented two species of *Pinnixa*.

A number of individuals of each form were examined and carefully reared in separate vessels. Two individuals of the long-spined form lived through the last zoea molt and came out in the early stage of the adult form, as well described by Mr. Faxon. Of the short-spined form a single individual was reared through the final zoea molt, and came out a megalops. I was not able during the season of 1875 to rear either the megalops or the young crab through another molt, or to repeat the former observations.

Though these observations were very remarkable, I wished to complete and confirm them, and, if possible, to determine to what particular species the two forms of zoea belonged, and so the publication of the observations was postponed; but no opportunity for completing them occurred, and in 1878 Mr. Faxon, though wholly ignorant of my observations, fortunately repeated the observations upon the long-spined zoea and published the results, together with a brief statement of my observations, and gave figures of the zoeæ which I obtained from the adult *Pinnixa* at Noank, Conn., in 1874. Mr. Faxon identified the adult *Pinnixa*, like those from which the zoeæ were obtained, with *P. chætopterana* of Stimpson, and, in his paper referred to, is the first to record the occurrence of this species on the New England coast.

During the summer of 1879 Prof. H. E. Webster obtained a large number of specimens of *Pinnixa* (which was before not known north of Cape Cod) at Wellfleet, on Cape Cod Bay, and sent them to me for identification. While examining these I have reëxamined the specimens previously obtained on the New England coast, in all between 60 and 70 specimens, and I find there are two quite distinct species among them. As indicated by these collections, by far the most common species is *P. chætopterana* Stimpson, and among the specimens taken by Prof. Webster in Cape Cod Bay, this is the only species represented. From Vineyard Sound, Buzzard's Bay, and Long Island Sound, however, there are a few specimens of a different species, the one which I have figured and referred to as *P. cylindrica* (Say sp.) It is apparently not Say's species, however, but the species described by Stimpson as *P. Sayana*. Stimpson appears to have had only males and his specimens were dredged in 6 fathoms, off the mouth of Beaufort Harbor, North Carolina. The distinctive features of these two species are pointed out further on.

Having ascertained that the adults of two species of *Pinnixa* inhabit the New England coast, it is a matter of considerable interest to determine whether either or both of these are the same as either

or both of the species which Mr. Faxon and I have observed to differ so widely in regard to the megalops-stage.

The young in the first zoea-stage figured by Mr. Faxon (pl. 4, figs. 1-4) were obtained directly from the eggs of *P. chætopterana* and are of course unquestionably of that species. That the later stages figured by Mr. Faxon (pl. 4, figs. 5-15, and pl. 5) do not belong to the same species as the young in the first zoea-stage, is shown by the difference in the length of the dorsal and rostral spines in the first and last zoea-stages, and by the presence, in the zoeæ in the first stage, of the central lobe of the posterior margin of the telson, while it is wholly wanting in the zoeæ in the last stage. In the several species of *Brachyura* in which I have examined a series of zoeæ in different stages, the dorsal and rostral spines are proportionally not much if at all longer in the first than in the last stage, and there is often a considerable decrease in the length of these spines in passing from next to the last to the last stage: *Pinnixa* is probably not an exception to this rule. Moreover, among the zoeæ of *Pinnixa* taken in Vineyard Sound in 1875, there are a few specimens of the long-spined form which are evidently in the penultimate zoea-stage, and they agree fully with the numerous specimens in the last stage in the length of the spines and in the form of the telson.

On the other hand the short-spined zoeæ which I observed to pass into a megalops-stage agree with the first stage of the zoeæ from the eggs of *P. chætopterana*, not only in the length of the spines but also perfectly in the form of the telson, the median lobe of the posterior margin being developed precisely as in the zoeæ of the first stage and as figured by Mr. Faxon (pl. 4, fig. 2, *b*). This is sufficient evidence, I think, to show that the short-spined zoeæ upon which my observations were based are the young of *P. chætopterana*, and that the long-spined form, which both Mr. Faxon and I observed to pass directly from the zoea to the adult form, must belong to some other species. The fact that these long-spined zoeæ were very common both at Newport and in Vineyard Sound would seem to indicate a probability that they belong to some species regularly inhabiting the coast of Southern New England, and consequently that they are likely to prove the young of *P. Sayana*,—but this is only a probability. That both forms of the early stages belong to species of the same genus (as the genera of the group to which they belong are now understood) there can be no reasonable doubt, since one of the forms has now been traced from the eggs of a well-known species to the megalops-stage, and the other from the later zoea-stages to the early, but generically characteristic, stages of the adult form.

The following systematic account of the two species of *Pinnixa* above referred to gives the obvious specific characters of the adults and the principal bibliography of each species.

Pinnixa chætopterana Stimpson.

Pinnixa cylindrica Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 68 (22) 1859 (partial desc.; South Carolina, in tubes of *Chætopterus*) (*Non White nec Say* sp.)

Pinnixa chætopterana Stimpson, op. cit., vii, p. 235 (107), 1860 (desc.; syn.; same loc.) Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 324 (9), 1878 (North Carolina); op. cit., 1879, p. 402, 1880 (Virginia, Florida).

Faxon, Bulletin Mus. Comp. Zool. Cambridge, v, p. 263, pl. 4, figs. 1-4 (zoea), pl. 5, figs. 8, 9 (chelipeds), 1879 (Long I. Sd. and Buzzard's Bay).

The carapax is very broad and broader in the males than in the females, adult males and large females being two and a fourth times as broad as long. There is a distinct and minutely tubercular ridge along the anterior inferior edge of the branchial region just over the bases of the chelipeds; and above, and nearly parallel with this, there is a denticulated carina, or line of minute denticles, across the swollen branchial region, on a line from the base of the third ambulatory leg toward the eye, but not reaching the lateral margin of the carapax nor crossing the cervical suture, though there is a slight elevation on the hepatic region opposite the carina. This line of denticles is better marked in the females than in the males. The transverse crest upon the cardiac region is conspicuous in both sexes: in the female it is marked by a slender but sharp carina interrupted for about a third its length in the middle; while in the male the carina is even more broadly interrupted in the middle and projects each side in a very prominent, transversely elongated, dentiform protuberance.

In the male the chelipeds are much stouter than in the female: the propodus is nearly smooth, as long as the carapax and somewhat swollen in the middle; the prehensile edge is terminal, but projects distally considerably at the inferior angle, is nearly transverse, and armed with a triangular tooth near the base of the dactylus and usually with a minute one near the tip. The dactylus is stout, very strongly curved and the prehensile edge is nearly or quite smooth. In several of the males examined one of the chelipeds is a little smaller than the other and in all respects like the chelipeds of the female, but these were probably all cases of reproduced limbs.

In the female the chelipeds are smaller and proportionally less stout and more compressed than in the male; the propodus is shorter than the length of the carapax, and the digital portion is oblique, longer than in the male, and its tip is obliquely truncated so as to

leave an angular prominence near the middle of the prehensile edge. The dactylus is much longer and less curved than in the male, and its prehensile edge is armed with a small tooth about a third of the way from the base to the tip, and often with minute additional teeth either side of the principal one.

The first pair of ambulatory legs are slender and scarcely longer than the chelipeds; the second pair are a little longer and considerably stouter, but still slender; the dactyli in both pairs are rather slender, and in the female nearly as long as the upper edge of the propodus, but in adult males apparently a little shorter. The third pair are very large, about equally stout in the two sexes, and in adults about as long as the breadth of the carapax, but in young somewhat longer; the merus is about as long as the carapax and about half as broad as long; the upper edge is angular and usually minutely denticulated distally, there is a slight transverse groove at the distal end, the sides are smooth and rounded, but the inferior edge projects in a thin and conspicuously denticulated carina; there is a similar but much less conspicuous carina upon the propodus and also on the ischium; and there is a slight crest upon the upper edge of the carpus and propodus. The posterior ambulatory legs are short, reaching beyond the merus of the third pair, but they are much stouter than the second pair and the merus is carinated and grooved as in the third pair, though much less conspicuously.

The following measurements of the carapax and one of the third ambulatory legs in a number of specimens show the proportions of these parts of the animal more fully than the description.

No.	Sex.	Carapax:			Third ambulatory leg:			
		Length.	Breadth.	Ratio.	Length.	Merus.	Propodus.	Dactylus.
5	♂	3.9 ^{mm}	8.7 ^{mm}	1:2.23	9.4 ^{mm}	4.0 × 2.0 ^{mm}	2.0 × 1.4 ^{mm}	1.2 × 0.3 ^{mm}
3	"	3.9	8.8	1:2.26	9.5	4.0 2.0	2.0 1.4	1.2 0.4
1	"	4.0	9.1	1:2.27	9.7	4.1 2.1	2.0 1.5	1.3 0.4
3	"	4.1	9.3	1:2.26	9.8	4.2 2.1	2.0 1.5	1.3 0.4
3	"	4.4	10.0	1:2.27	10.5	4.4 2.2	2.2 1.6	1.4 0.5
3	"	4.5	10.2	1:2.27	11.2	4.6 2.3	2.0 1.5	1.4 0.5
5	"	4.7	11.0	1:2.34	11.0	4.7 2.5	2.2 1.8	1.5 0.5
3	"	4.9	11.5	1:2.35	11.0	5.0 2.4	2.3 1.8	1.5 0.6
4	♀?	2.3	4.7	1:2.04	6.0	2.3 0.9	1.3 0.6	1.0 0.2
3	♀	2.6	5.5	1:2.12	6.5	2.6 1.2	1.5 0.9	1.0 0.3
3	"	3.0	6.3	1:2.10	7.4	2.8 1.3	1.7 1.0	1.1 0.3
5	"	3.2	7.0	1:2.19	7.7	3.2 1.7	1.6 1.2	1.1 0.3
5	"	4.6	10.0	1:2.17	10.5	4.1 2.4	2.0 1.5	1.3 0.5
3	"	4.6	10.3	1:2.24	10.4	4.1 2.2	2.0 1.4	1.4 0.5
5	"	5.0	11.4	1:2.28	11.0	4.7 2.4	2.3 1.8	1.6 0.5
3	"	5.3	12.0	1:2.26	12.2	5.0 2.6	2.5 1.7	1.6 0.5

Specimens Examined.

No.	Locality.	Fath.	Bot.	When coll'd.	Rec'd from.	No. specimens:			Dry or Alc.
						♂	♀	with eggs	
1	Stony Creek, L. I. Sd.	shore	M., S.	May 15, '71	S. I. Smith	1			Alc.
2	Noank, Fisher's I. Sd.			Aug., 1874	U. S. F. Com.		5	2	"
3	Buzzard's Bay	dredg.		Aug., 1875	"	19	13	1	"
4	Vineyard Sound	surface		Aug. 25, '75	"	yng.	2		"
5	Wellfleet, C. Cod B.	shore		1879	H. E. Webster	10	9	1	"

No. 5 were all found in the tubes of *Amphitrite ornata* Verrill (Leidy sp.)

***Pinnixa Sayana* Stimpson.**

Pinnixa Sayana Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 236 (108), 1860 (desc. of ♂; North Carolina).

Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 323 (8), 1878.

Pinnixa cylindrica Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 546 (252), pl. 1, fig. 1, 1874 (Vineyard Sd. and Long I. Sd.) (*Non Say sp. nec Stimpson*).

? *Pinnixa* sp. Faxon, Bulletin Mus. Comp. Zool. Cambridge, v, p. 263, pl. 4, figs. 5-15, pl. 5, figs. 1-7, 1879 (early stages; Newport, Rhode Island).

The carapax is narrower than in *P. chaetoptera*, but still nearly, or even somewhat more than, twice as broad as long. There is a tuberculose ridge along the anterior inferior margin as in *P. chaetoptera*, and above and nearly parallel with it a sharp denticulated carina extending from the base of third ambulatory leg across the branchial region and across the cervical suture to the hepatic region, being most conspicuous at the cervical suture, and separating the dorsal from the nearly perpendicular antero-lateral border of the carapax. In the female there is no carina on the cardiac region, only an obtusely angular ridge separating the flat dorsal from the inclined posterior dorsal region; while in the male (as already described by Stimpson) the ridge is marked by a very slender, but acute, carina not interrupted in the middle.

The chelipeds in the one male examined are unequal, the smaller being in all respects like the chelipeds of the female, while the other (apparently of the normal form for the male) is very much as in the male *P. chaetoptera*, though apparently a little smaller in proportion. The tooth near the base of the digital portion of the propodus is inconspicuous but still clearly discernible.

The first and second pairs of ambulatory legs are long and very slender, the first pair being longer than the chelipeds, and the second considerably longer than the breadth of the carapax. The third pair are only a little longer than the second and proportionally consider-

ably stouter, but very much less stout than in *P. chatopterana*: the merus is about three times as long as broad, the posterior surface is somewhat rough and granular and there is a minutely tubercular and granular carina on the lower edge, but there is no well marked groove across the distal end; there are two lines of granules along the lower edge of the propodus but no real carina. The posterior legs are very much like the third pair except that they are much smaller, reaching only to the distal ends of the carpi of the third pair. The dactyli of all the ambulatory legs are long, slender and nearly straight.

Measurements.

No.	Sex.	Carapax.			Third ambulatory leg:			
		Length.	Breadth.	Ratio.	Length.	Merus.	Propodus.	Dactylus.
5	♂	2.8mm	5.4mm	1:1.93	8.0mm	3.2 × 0.9mm	1.7 × 0.6mm	1.5 × 0.2mm
5	♀	2.7	5.2	1:1.94	7.6	2.9 0.8	1.4 0.4	1.4 0.2
5	"	2.9	5.6	1:1.93	7.2	2.7 0.8	1.4 0.5	1.3 0.2
5	"	3.3	6.7	1:2.03	8.2	3.2 1.0	1.6 0.6	1.4 0.3
1	"	3.4	6.8	1:2.00	8.7	3.3 1.1	1.7 0.7	1.5 0.3
4	"	3.7	7.4	1:2.00	9.1	3.8 1.2	1.8 0.7	1.6 0.3
2	"	3.7	7.7	1:2.08	9.0	3.6 1.2	1.9 0.8	1.6 0.3
3	"	4.3	8.7	1:2.02	10.1	4.0 1.4	2.0 1.0	1.7 0.3

Specimens Examined.

No.	Locality.	Fath.	Bot.	When coll'd.	Rec'd from.	No. specimens:			Dry or Alc.
						♂	♀	with eggs.	
1	New Haven, L. I. Sd.	dredged			A. E. Verrill		1	0	Alc.
2	" "	"		1869	A. D. Chidsey		1	0	"
3	" "	shore		May 22, '72	A. E. Verrill		1	0	"
4	Vineyard Sound			1871	U. S. F. Com.		1	0	"
5	Buzzard's Bay	dredged	M.	1875	"	1	3	1	"

VI. OCCASIONAL OCCURRENCE OF TROPICAL AND SUB-TROPICAL SPECIES OF DECAPOD CRUSTACEA ON THE COAST OF NEW ENGLAND. BY S. I. SMITH.

SOME years ago I called attention to the occurrence of the young of a southern species of *Ocypode* on the south shore of Long Island and the coast of southern New England, and more recently Mr. Faxon has recorded the similar occurrence, at Newport, Rhode Island, of *Polyonyx macrocheles* and, incidentally, of *Calappa marmorata*. Since my first observations were published a considerable number of new observations have been made and additional species have been found to occur in a similar way, so that it seemed desirable to bring together all the observations with the view of calling special attention to the subject. This is attempted in the following list which includes all the tropical and sub-tropical species which are known to me to occur, in any stage of the adult form, on the New England coast. The pelagic species which I have mentioned as found near the borders of the Gulf Stream, off St. George's Banks (these Transactions, vol. iii, p. 26; vol. v, pp. 120-122), are doubtless all regular inhabitants of the Gulf Stream even much north of New England, and all probably occur occasionally on the coast of southern New England, but only those which have actually been observed in the bays and sounds along the coast itself are included in the list. Of the species included, *Nautilograpsus minutus*, *Neptunus Sayi*, and *Latreutes ensiferus* belong to the pelagic fauna of the Gulf Stream. The others are all southern species which either drift north in the free-swimming early stages and partially complete their development on our coast, like *Ocypode quadrata* and *Polyonyx macrocheles*, or are accidentally carried north in some stage of the adult form and survive for a short time in summer, like *Pachygrapsus transversus*. I have not intended to include any species which could, in any sense, be regarded as properly belonging to the fauna of the New England coast.

***Ocypode quadrata* J. C. Fabricius.**

Cancer quadratus J. C. Fabricius, Entomologia Systematica, ii, p. 439, 1793 (diagnosis; "Habitat in Jamaica Mus. Dom. Banks.")

Ocypode quadrata J. C. Fabricius (continued).

- Herbst, Krabben und Krebse, i, p. 257, 1782 (= Fabricius).*
- Ocypode quadrata* J. C. Fabricius, Supplementum Entomol. System., p. 347, 1798.
- Bosc, Hist. nat. Crust., i, pp. 194, 198, 1802 (*Ocypoda*; = Fabricius).
- Latreille, Hist. nat. Crust. Ins., vi, p. 49, 1803 (= Fabricius).
- Ocypoda albicans* Bosc, Hist. nat. Crust., i, p. 196, pl. 4, fig. 1, 1802 (Carolina coast; the figure is very bad and probably not based on the specimens described in the text, the eye-stalks being prolonged as in *O. ceratophthalma*.)
- Latreille, Hist. nat. Crust. Ins., vi, p. 48, 1803 (= Bosc).
- Ocypode arenarius* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 69, 1817.
- M.-Edwards, Hist. nat. Crust., ii, p. 44, pl. 19, figs. 13, 14, 1837 (*Ocypoda arenaria*); Ann. Sci. nat., III, xviii, p. 143 (107), 1852 (*Ocypode arenaria*).
- White, List Crust. British Mus., p. 34, 1847 (*Ocypode arenaria*).
- Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 180 (16), 1850 (*arenaria*).
- Coues, Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 122 (*arenaria*; North Carolina; habits).
- Von Martens, Archiv für Naturgesch., xxxviii, p. 103, 1872 (*arenaria*).
- Smith, Amer. Jour. Sci., III, vi, p. 67, 1873 (*Monolepis inermis*=megalops-stage); Inverteb. Vineyard Id., Report U. S. Fish Comm., i, p. 545 (251), 534 (240), 1874 (*Ocypoda arenaria*).
- Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 322 (7), 1878 (*Ocypoda arenaria*); op. cit., 1879, p. 400, 1880.
- Ocypoda rhombea* M.-Edwards, Hist. nat. Crust., ii, p. 46, 1837 ("Antilles et Brésil"); Ann. Sci. nat., III, xviii, p. 143 (107), 1852 (*Ocypode*).
- White, List Crust. British Mus., p. 35, 1847 (*Ocypode*; Jamaica).
- Dana, U. S. Expl. Exped., Crust., p. 322, pl. 19, fig. 8, 1852 (Brazil).
- Monolepis inermis* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 157, 1817.
- M.-Edwards, Hist. nat. Crust., ii, p. 264, 1837.
- White, List Crust. British Mus., p. 65, 1847.
- Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 192 (28), 1851.
- Cancer arenarius* Catesby, Nat. Hist. Carolina, ii, pl. 35, 1743.

In 1873 I called attention to the occurrence of the young of this species on the coast of New England and Long Island, and suggested its relation to the *Monolepis inermis* of Say. Since then a great number of the megalops have been taken in Vineyard Sound by Mr. V. N. Edwards, and, early in September, 1875, I took several specimens swimming at the surface in the same region. One of the latter specimens, after being kept alive for some days, buried itself in the sand preparatory to molting, but died before this was fully accomplished. The molting was sufficiently advanced, however, to show

* The sign of equality (=), as here introduced after a reference, is used to indicate that the description, mention, or whatever account of the species may be given in the work referred to, is apparently based wholly on the previous account given by the author whose name follows the sign.

clearly the form of the young *Ocypode* within the megalops skin and to establish unequivocally my former conclusion that Say's *Monolepis inermis* is really the megalops-stage of this species of *Ocypode*.

I have examined a very large series of specimens of the adult form of this species from Brazil; St. Thomas; Aspinwall; Nassau, New Providence; Texas; Key West, and Sarasota Bay, Florida; the Bermudas; North Carolina; New Jersey; and the south shore of Long Island: and, between specimens of the same size, I can find no differences which could be regarded as specific, though young specimens differ much from adults, and these differences have probably led to the admission of the two nominal species, *arenaria* and *rhombea*.

This species is evidently the *O. quadrata* of Fabricius: the original description of *Cancer quadratus* agrees in every respect, and the comparison with *C. ceratophthalmus* ("Affinis *C. ceratophthalmo* at oculi simplicis") and the habitat ought to leave no doubt whatever on this point. DeHaan, however, refers Fabricius' species to a Japan *Sesarma* (*Grapsus* (*Pachysoma*) *quadratus* DeHaan, Fauna Japonica, p. 62, pl. 8, fig. 3), although he had already (op. cit., p. 29) retained it in the genus *Ocypode*. Succeeding authors have failed to restore Fabricius' species to its proper place. Fabricius' *Ocypode rhombea*, of which the habitat was unknown, is certainly not this species, nor of the genus *Ocypode* in the modern sense, as the first line of the diagnosis, "thorace laeviusculo utrinque unidentato," plainly shows. If ante-Linnean names, when occasionally binomial, are to be adopted, then Catesby's *arenarius* may be retained.

When writing the report on the crustacea of Vineyard Sound, I had not been able to consult Fabricius' works, and stated that "the Brazilian species, usually called *rhombea* appears to be identical with ours, and if it is really the *rhombea* of Fabricius, his name should undoubtedly be retained." This remark is quoted verbatim in order to correct Mr. Kingsley's statement (Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 322 (7), 1878) that I say "that our form seems to be identical with the Brazilian one, which is known as *O. rhombea* Fabricius, in which case the name *rhombea* will hold."

Grapsus pictus Lamarck.

Cancer grapsus Linné, Systema Naturæ, ed. xii, i, p. 1048, 1767; Amoenit. Acad., 2d ed., iv, p. 252, pl. 3, fig. 10, 1788.

Herbst, Krabben und Krebse, i, p. 115, 1782.

J. C. Fabricius, Systema Entomologiæ, p. 406, 1775; Entomologia System., ii, p. 438, 1793; Suppl. Entom. System., p. 342, 1798.

Grapsus pictus Lamarck (continued).

Grapsus pictus Lamarck, *Système Animaux sans Vertèb.*, p. 150, 1801.

Bosc, *Hist. nat. Crust.*, i, p. 202, 1802.

Latreille, *Hist. nat. Crust. Ins.*, vi, p. 69, 1803.

Desmarest, *Consider. Général. Crust.*, p. 130, pl. 16, fig. 1, 1825.

M.-Edwards, *Hist. Nat. Crust.*, ii, p. 86, 1837 (Antilles); *Règne animal de Cuvier*, 3^{me} édit., pl. 22, fig. 1.

Gibbes, *Proc. Amer. Assoc. Adv. Sci.*, 3d meeting, p. 181 (17) 1850 (Florida).

Dana, *U. S. Expl. Expd.*, *Crust.*, p. 336, 1852 (Madeira, Cape Verds, Peru, Paumotu Archipelago, Sandwich Is.)

Saussure, *Revue Mag. Zool.*, II, v, p. 362 (9), 1853 (Mazatlan).

Nicolet, in Gay, *Hist. de Chile, Zool.*, iii, p. 166, 1854 (= *G. ornatus* M.-Edwards).

Stimpson, *Jour. Boston Soc. Nat. Hist.*, vi, p. 466 (26), 1857 (= *G. pictus* De Saussure, but supposed not to be that of Latreille).

Streets, *Proc. Acad. Nat. Sci. Philadelphia*, 1871, p. 240 (no description; Isthmus of Panama).

Miers, *Proc. Zool. Soc. London*, 1877, p. 73 (Galapagos Is.; > *G. altifrons* Stimp.)

Von Martens, *Archiv. Naturgesch.*, xxxviii, 1872, p. 106 (Cuba).

Hilgendorf, *Monatsb. Akad. Wissensch. Berlin*, 1878, p. 807 (Mozambique).

Grapsus (Goniopsis) pictus DeHaan, *Fauna Japonica, Crust.*, p. 33, 1835.

Grapsus strigosus Brullé, in Barker-Webb et Berthelot, *Hist. nat. Iles Canaries, Entomologie*, p. 15, 1835 (no description; = *G. Webbi*, teste M.-Edwards).

? Stimpson, *Jour. Boston Soc. Nat. Hist.*, vi, p. 446 (26), 1857 (= *Goniopsis strigosus* White, in part).

? Hoffmann, *Faune de Madagascar, Crust.*, p. 20, pl. 5, fig. 31, 1874.

Goniopsis picta Krauss, *Südafrikan. Crust.*, p. 46, 1843.

? *Goniopsis strigosus* White, *List. Crust. British Mus.*, p. 40, 1847 (in part, probably specimens *d* and *j*, Gulf of California).

Grapsus maculatus M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 167 (133), pl. 6 (= pl. 22, *Règne animal de Cuvier, Crust.*), 1853 (Antilles).

Saussure, *Crust. Mexique et Antilles (Mém. Soc. Phys. Hist. nat. Genève, xiv)*, p. 32, 1858 (*G. maculatus*?).

Stimpson, *Ann. Lyceum Nat. Hist. New York*, vii, p. 229 (101), 1860 (Florida).

Kingsley, *Proc. Acad. Nat. Sci. Philadelphia*, 1879, p. 401 (Santa Cruz, Tahiti).

Hoffmann, *Faune de Madagascar, Crust.*, p. 21, pl. 6, figs. 36-38, 1874.

Grapsus maculatus, var. *Pharaonis*, A. M.-Edwards, *Nouv. Arch. Mus. Paris*, ix, p. 285, 1873.

Grapsus Pharaonis M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 168 (134), 1853 (Red Sea).

Heller, *Sitzungsb. mathem.-naturw. Classe Akad. Wissensch.*, xliii, p. 362, 1861.

Hoffmann, *Faune de Madagascar, Crust.*, p. 20, pl. 5, figs. 32-35, 1874.

Grapsus ornatus M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 168 (134), 1853 (Chili).

Grapsus Webbi M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 167 (133), 1853 (= *G. strigosus* Brullé; Canary Is.)

Stimpson, *Proc. Acad. Nat. Sci. Philadelphia*, 1858, p. 102 (48).

Grapsus altifrons Stimpson, *Ann. Lyceum Nat. Hist. New York*, vii, p. 230 (102), 1860 (Cape St. Lucas).

Pagurus maculatus Catesby, *Nat. Hist. Carolina*, ii, pl. 36, 1743 (Florida).

The only specimen I have seen from the New England coast is a small one taken alive, in 1877, by Mr. J. M. Blake, in Provincetown Harbor, Cape Cod Bay, from a whaler just in from sea. This specimen differs so much from the adult *G. pictus* of Florida and the West Indies that it might readily be taken for a different species. The carapax is very much narrower proportionally than in adults, and the branchial regions are less swollen. The front and epistome are more like *G. strigosus* than the adult *pictus*: the front is not perpendicular as in the adult but very oblique, the median and lateral protogastric lobes being much less angular in front and much back of the frontal margin itself; the relative proportions of these lobes, however, and the other characters of the areolation of the carapax agree well with adult specimens. A series of young specimens of *G. pictus* from the coast of Brazil shows, by direct gradations in the form of the front and the relative proportions of the carapax, that the small specimen from Provincetown is an immature individual of this abundant tropical species, which, as far as I know, has not before been recorded from the western side of the Atlantic north of Florida and the Bermudas.

In the adult condition this species appears to vary slightly in the height of the front and the character of the frontal lobes, and considerably in coloration, but I can see no reason for regarding the form, from Chili, named *ornatus* by Milne-Edwards, or that, from the Gulf of California, called *altifrons* by Stimpson, as distinct species. I have examined a considerable number of specimens of the typical *pictus* from Bermuda and from Key West, Florida, two large specimens of the *ornatus* from Callao, Peru, and two large specimens of the *altifrons* from La Paz, Lower California; and I find no characters whatever in the form of the carapax, or in the proportions or armament of the chilipeds or ambulatory legs, by which these supposed species can be distinguished. In the coloration of these specimens there is an apparent difference between those from the Atlantic and those from the Pacific, but still not sufficient, I think, to distinguish them even as geographical color varieties. All the specimens appear to have the same pattern of coloration, but in those from the Gulf of California and Peru the red very much predominates, while in Atlantic specimens the yellow markings appear to occupy a larger proportion of the surface. The Atlantic specimens vary much in this respect, however, and the coloration of some of those from Bermuda approaches very nearly that of the specimens from the west coast of America, and I have no doubt that a large series of specimens from

different localities would show a complete gradation between the extremes of coloration.

The following table of measurements shows the variation in the proportions of the carapax due to age, and the complete correspondence in the proportions of specimens of similar size from Bermuda and Key West, on the one hand, and Lower California and Peru, on the other. In order to show more clearly the relative proportions of the carapax, the measurements in the last three divisions of the table are given first in millimeters and then in the unit of the length of the carapax. In regard to the height of the front, which is not given in the table, it may be mentioned that it is absolutely higher in the largest specimen from the Bermudas than in either of the specimens from La Paz.

Locality; sex.	Length of Carapax.	Breadth of Carapax:		
		Greatest.	At anterior angles.	Of front.
<i>a</i>	10.7 ^{mm}	13.7 ^{mm} 1.26 lgth.	11.5 ^{mm} 1.07 lgth.	5.0 ^{mm} .45 lgth.
<i>b</i>	11.7	14.3 1.22	12.1 1.03	5.3 .45
<i>b</i> ♂	14.5	17.0 1.17	13.8 0.95	6.6 .45
<i>b</i> ♂	16.2	18.9 1.16	14.8 0.91	7.1 .44
<i>b</i> ♀	18.5	21.3 1.15	16.8 0.91	8.0 .43
<i>b</i> ♀	21.0	24.0 1.14	18.4 0.88	8.8 .42
<i>c</i> ♂	37.2	40.5 1.09	29.5 0.79	14.7 .40
<i>d</i> ♂	43.0	47.3 1.10	34.6 0.80	17.0 .40
<i>d</i> ♂	57.0	61.4 1.08	43.0 0.77	22.5 .39
<i>c</i> ♂	67.0	73.8 1.10	47.7 0.71	26.8 .40
<i>e</i> ♂	60.0	65.4 1.09	43.0 0.70	24.0 .40
<i>e</i> ♂	65.0	72.5 1.11	46.0 0.71	26.0 .40
<i>f</i> ♀	59.0	64.0 1.08	41.5 0.70	22.8 .39

a, Provincetown, Mass. *b*, Brazil (C. F. Hartt). *c*, Bermuda (G. Brown Goode). *d*, Key West, Fla. (received from Dr. Harrison Allen). *e*, La Paz, Lower California (J. Pedersen). *f*, Callao, Peru (F. H. Bradley).

The geographical distribution of the species is, perhaps, sufficiently indicated by the localities given above in the synonymy.

Pachygrapsus transversus Stimpson.

Grapsus transversus Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 181 (17), 1850 (Florida; said to belong to "*Pachygrapsus* if that be adopted.")

Pachygrapsus transversus Stimpson, Ann. Lyc. Nat. Hist. New York, vii, p. 64 (18), 1859; Amer. Jour. Sci., II, xxvii, p. 446, 1859; Ann. Lyc. Nat. Hist. New York, x, p. 113, 1871.

Smith, Report Peabody Acad. Sci. Salem, 1869, p. 91, 1871 (Pacific coast Central America).

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Locality; sex.	Length of Carapax.	Breadth of Carapax:		
		Greatest.	At anterior angles.	Of front.
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<i>b</i>	11·7	14·3 1·22	12·1 1·03	5·3 ·45
<i>b</i> ♂	14·5	17·0 1·17	13·8 0·95	6·6 ·45
<i>b</i> ♂	16·2	18·9 1·16	14·8 0·91	7·1 ·44
<i>b</i> ♀	18·5	21·3 1·15	16·8 0·91	8·0 ·43
<i>b</i> ♀	21·0	24·0 1·14	18·4 0·88	8·8 ·42
<i>c</i> ♂	37·2	40·5 1·09	29·5 0·79	14·7 ·40
<i>d</i> ♂	43·0	47·3 1·10	34·6 0·80	17·0 ·40
<i>d</i> ♂	57·0	61·4 1·08	43·0 0·77	22·5 ·39
<i>c</i> ♂	67·0	73·8 1·10	47·7 0·71	26·8 ·40
<i>e</i> ♂	60·0	65·4 1·09	43·0 0·70	24·0 ·40
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Smith, Report Peabody Acad. Sci. Salem, 1869, p. 91, 1871 (Pacific coast Central America).

order to give the readiest means of comparison, the breadth and the breadth of the front are given first in millimeters and then, in the same divisions of the table, in units of the length of the carapax.

Locality.	Sex.	Length.	Breadth.	Front.
Bermuda, -----	young.	3.6mm	5.0mm 1.39 lgth.	2.6mm .72 lgth.
" -----	"	4.0	5.5 1.37	2.8 .70
" -----	"	5.1	7.0 1.37	3.8 .74
" -----	♀	5.6	7.8 1.39	4.3 .77
" -----	"	7.4	10.4 1.40	5.7 .77
" -----	"	8.2	11.1 1.35	5.8 .71
Paíta, Peru, -----	"	8.5	11.0 1.30	5.9 .69
Acajutla, -----	"	9.8	13.1 1.34	7.2 .73
Provincetown, -----	"	10.1	13.2 1.31	7.2 .71
Florida, -----	"	11.0	15.0 1.36	8.3 .76
" -----	"	11.4	15.9 1.40	8.8 .77
Brazil, -----	"	11.5	15.6 1.36	8.6 .75
Acajutla, -----	"	13.7	18.2 1.33	9.8 .71
Bermuda, -----	"	14.2	19.0 1.34	10.8 .76
Provincetown, -----	♂	6.0	7.9 1.30	4.1 .68
Florida, -----	"	7.0	9.3 1.33	5.0 .71
Provincetown, -----	"	7.5	10.0 1.33	5.0 .67
" -----	"	9.0	11.5 1.28	6.3 .70
Bermuda, -----	"	9.4	12.8 1.36	6.9 .73
Paíta, Peru, -----	"	10.0	12.8 1.28	7.0 .70
Bermuda, -----	"	10.5	13.7 1.30	7.6 .72
Panama, -----	"	10.5	13.9 1.32	7.6 .72
Bermuda, -----	"	10.7	14.1 1.32	7.8 .73
Panama, -----	"	10.7	14.2 1.32	7.7 .72
Brazil, -----	"	11.0	14.3 1.30	7.6 .69
Bermuda, -----	"	12.4	16.4 1.32	9.0 .73
Florida, -----	"	12.5	16.3 1.30	8.9 .71
Bermuda, -----	"	13.1	17.2 1.31	9.6 .73
Panama, -----	"	13.8	17.4 1.26	9.8 .71
Brazil, -----	"	14.5	18.2 1.25	10.0 .69
Panama, -----	"	15.2	19.4 1.27	10.6 .70
Brazil, -----	"	15.3	19.7 1.29	10.6 .69
Bermuda, -----	♀	9.2	13.0 1.41	7.1 .77

The limits of variation as shown in the table are found in Atlantic specimens. Considering the considerable variation in the proportions of specimens of about the same size, the differences in this respect between the smallest and the largest specimens measured is surprisingly small. The carapax appears to grow proportionally very slightly narrower with increasing size, as I have noticed in a few other species of Grapsoidea, though the reverse is usually the case in nearly all groups of Brachyura, and is what we should naturally expect from the increase, during the early growth of the animal, in the functional importance of the branchiæ.

The measurements given in the last line in the table are of a parasited specimen with one of the branchial regions considerably distorted.

Nautilograpsus minutus Milne-Edwards.

A large male of this common pelagic species of the Gulf Stream was taken at Woods' Holl, Vineyard Sound, September 11, 1877, by V. N. Edwards. Length of carapax, 15.1^{mm}; greatest breadth, 14.8; breadth of front between bases of eyes, 9.7; breadth between anterior angles, 13.0.

It has been recorded from the English coast by White, Bell, and others; the Mediterranean, Heller; Cape St. Lucas, Stimpson; Indian Ocean, Milne-Edwards.

Pinnotheres ostreum Say is brought north in considerable numbers in oysters from the Chesapeake and, very likely, occasionally survives for a considerable time in oysters planted on the New England coast, but, as far as I can learn, it is never found in native New England oysters or in those which have been planted here for any considerable time. It may, therefore, properly have claim to a place in the list. I have never seen the male on the New England coast. The figure, purporting to represent the male of this species, which I have given in the Report on the Invertebrate Animals of Vineyard Sound, is in reality the figure of the male of *Pinnotheres maculatus*.

Neptunus Sayi Stimpson (ex Gibbes).

Young specimens of this common pelagic species of the Gulf Stream were several times taken in Vineyard Sound during August and September, 1875. None of the specimens observed were more than 12 to 15^{mm} across the carapax. The megalops of this, or of some closely allied species was taken at the same time.

Calappa marmorata Fabricius.

While at Woods' Holl, with the party of the U. S. Fish Commission, in the summer of 1875, I was surprised at the occurrence of a very remarkable megalops evidently an early stage of some species of *Calappa*, though the genus was at the time not known to me to occur, on our coast, north of the Carolinas. Before leaving Woods' Holl, however, Mr. V. N. Edwards informed me that a small crab, unlike any before known to him, had been found the previous season, under stones at low water, on Ram Island near Woods' Holl, by Mr. Benja. Smith. The specimen was brought to me by Mr. Edwards and proved to be a young *Calappa marmorata*, with the carapax 22^{mm} long. The shores of the same island and other similar localities were carefully searched, during September, 1875, without finding additional specimens. In 1878, however, Mr. Edwards forwarded

another specimen found at Woods' Holl. These two specimens are very nearly of the same size, the last one being very slightly the larger.

These young specimens, though having most of the essential specific characters of the adult *Calappa marmorata*, yet differ so much that they might readily be mistaken for a distinct species when compared with large specimens. The carapax is much narrower than in the adult, the breadth, including the lateral teeth, being only about a fourth greater than the length. The dorsal surface is more convex and more tuberculose, the tubercles being proportionally much larger and more prominent, giving the carapax a much rougher appearance. In fact the carapax resembles that of *C. convexa* of the west coast of America more than it does the adult *marmorata*, except that it has not the crenulated transverse carinæ above the posterior margin and the similar carinæ upon the teeth of the postero-lateral margin.

The *C. convexa* is sufficiently distinguished from the *marmorata* by these crenulated carinæ, though the proportions of the carapax, which are given by Stimpson as distinctive, are wholly inadequate to distinguish it, as the following table of measurements will show. Stimpson evidently compared small specimens of *convexa* with large ones of *marmorata* without making sufficient allowance for the changes in the proportions of the carapax with increasing size.

In the last division of the following table, the breadth of the carapax is given just in front of the three most posterior teeth of the lateral margin, and the breadth given in each of the last two divisions of the table is given first in millimeters and then in the length of the carapax as a unit.

Locality.	Dry, Alc.	Sex.	Length of Carapax.	Breadth of carapax:	
				Including teeth.	In front of teeth.
<i>C. marmorata.</i>					
Vineyard Id., -----	Dry		22.0 ^{mm}	27.0 ^{mm} 1.23 lgth.	----- ^{mm} ----- lgth.
" " -----	Alc.	♂	22.5	28.4 1.26	25.9 1.15
Bermuda, -----	"	♀	34.3	46.5 1.35	39.8 1.16
Key West, -----	"	♀	47.1	66.0 1.40	57.7 1.22
Egmont Key, -----	"	♀	54.0	78.0 1.44	70.6 1.31
" -----	"	♂	58.0	84.9 1.46	75.5 1.30
Key West, -----	Dry	♂	69.0	106.3 1.54	92.0 1.33
Brazil, -----	Alc.	♂	73.5	111.0 1.59	95.2 1.30
<i>C. convexa.</i>					
La Paz, L. C., -----	Dry	♀	54.0	77.2 1.43	70.0 1.30
" -----	"	♂	77.0	115.6 1.50	101.2 1.31
" -----	"	♂	86.0	135.0 1.57	119.0 1.38
" -----	"	♂	99.0	156.0 1.58	140.0 1.40

The megalops-stage of *C. marmorata* is so peculiar that I insert the following description. The length of the carapax is 3.0^{mm}; the breadth between the antero-lateral angles, 1.8; greatest breadth, 2.1. The lateral margins of the carapax are considerably expanded over the branchial regions, and the dorsal surface is smooth and strongly convex. The front is broad between the bases of the eyes, tapers to an acute-triangular tip, and is very strongly deflexed so that the terminal portion is perpendicular and the tip on a level with the sternum; the terminal portion is also transversely concave in front, so that, when seen from above, it projects only a little in front of the eyes, and shows a slight emargination in the middle. The eyes are large, the diameter being equal to more than half the breadth of the front between their bases, and project considerably beyond the sides of the carapax. The antennæ are very slender and scarcely longer than the breadth of the front between the bases of the eyes. The external maxillipeds have already assumed the form characteristic of the adult Calappidæ. The chelipeds are short and very stout, and in general form approach strongly those of the adult, but are smooth and unarmed with tubercles or spines, except upon the prehensile edges of the pincers. The merus and carpus are stout and swollen; the body of the propodus is stout and broadly expanded above distally, but the upper edge is smooth and rounded; the digital portion is long, slender, bent downward at nearly a right angle to the rest of the propodus, incurved at the very slender tip, and its prehensile edge slightly tubercular. The dactylus is slender and curved like the propodus, so that the tips of the digits cross when the pincers are closed. The prehensile edge of the dactylus in both chelipeds is armed like the digital portion of the propodus, and in one of the chelipeds there is in addition a stout tooth near the base corresponding to the similar tooth at the base of the dactylus in one of the chelipeds of the adult. The ambulatory legs are small and slender, and the dactylus in the posterior pair is armed at the tip with the three long setæ usually characteristic of these appendages in the megalops-stage. The abdomen is small in proportion to the rest of the animal, tapers very slightly distally, and is strongly convex above. The postero-lateral angles of the second to the fifth segment are prolonged downward into obtuse teeth. The sixth segment is very short, being less than half as long as broad. The telson is as broad as the sixth segment, but shorter than broad and with the posterior margin nearly semicircular. The appendages of the second to the fifth segment of the abdomen are of the usual form and

structure, with large outer and small inner lamellæ. The uropods are small, with a very short base, and a single broad oval lamella which reaches only a little beyond the tip of the telson.

When the megalops is at rest, the abdomen is curved beneath the body, and the chelipeds and ambulatory legs are folded very compactly beneath the carapax.

The specimens examined were all taken at the surface of the water in the evening, August 26 and 27, and September 2, 1875.

Polyonyx macrocheles Stimpson (ex Gibbes).

Mr. Faxon (Bull. Mus. Comp. Zool., Cambridge, v, p. 256, 1879) states that the adult of this species has been detected once, by Alexander Agassiz, under stones on the shore at Newport, R. I. Mr. Faxon also says: on several warm days in August, 1878, the zoeæ of *Porcellana* [*P. macrocheles*] swarmed in the streaks of smooth water on the edge of the tidal currents at the mouth of Narragansett Bay." Alexander Agassiz had previously observed the zoea of this species at Newport (Proc. Boston Soc. Nat. Hist., x, p. 222, 1866). I have never observed any stage of the species in Vineyard Sound or elsewhere on the New England coast. The adult appears to be not uncommon as far north as Beaufort, North Carolina.

Petrolisthes armatus Stimpson (ex Gibbes). A small specimen of this species was found in a bottle with other invertebrata collected, by Prof. Verrill and a party of students, at Stony Creek, on Long Island Sound, near New Haven, in the autumn of 1867 or 1868. At the time it was brought in, I suspected, without any good reason, that a stray specimen had been accidentally taken out on the excursion in one of the bottles and, in this way, got mixed with the specimens collected; but now I have little doubt that it was an erratic specimen from much further south. As far as I am aware, the species is otherwise not known north of Florida and the Bermudas.

Latreutes ensiferus Stimpson (ex M.-Edwards).

Several small specimens of this Gulf Stream species were taken at the surface in Vineyard Sound, during August and September, 1875.

Penæus Brasiliensis Latreille.

I have never seen specimens of this species from the New England coast, but Professor Verrill tells me that the live specimens of a large *Penæus*, in all probability this species, on exhibition at the New York Aquarium in the autumn of 1877, were said, by the Superintendent of the Aquarium, to have been taken on the Connecticut shore of Long Island Sound. Dr. Stimpson (*Annals Lyceum Nat. Hist. New York*, x, p. 232, 1871) had already recorded its occurrence in a fresh-water creek near Somers' Point, New Jersey, and in the Croton River, Sing Sing, New York, so that there can be little doubt that it occasionally extends to the shores of Long Island Sound. It is apparently common from North Carolina! to Brazil!; it is reported from the west coast of Africa by Miers (*Proc. Zool. Soc. London*, 1878, p. 299), and from the west coast of Central America by Kingsley (*Proc. Acad. Nat. Sci. Philadelphia*, 1879, p. 427, 1880).

**VII. ON THE AMPHIPODUS GENERA, CERAPUS, UNCIOLA, AND LEPI-
DACTYLIS, DESCRIBED BY THOMAS SAY. BY S. I. SMITH.**

The genus Cerapus.

SAY's description of the structure and habits of his *Cerapus tubularis*, though incomplete and, in regard to some of the structural details, incorrect, certainly indicates a remarkable amphipod very unlike any of the other species which have been referred to the genus. Though described by Say in 1817 from specimens found "amongst fuci on the sea beach at Egg-Harbor [New Jersey] in considerable numbers," it seems to have remained unknown for more than fifty years. It was searched for in vain at the original locality by Professor Verrill and myself in April, 1871, but in June of the same year I dredged a few specimens in Vineyard Sound. These specimens were unfortunately all females, while Say's description and figures were based on the male only, so that I did not feel entirely certain of their identity with Say's species. In the Report on the Invertebrate Animals of Vineyard Sound, I inserted the species under Say's name, with a query, and, after briefly describing the coloration and habits, remarked that, "in the structure of the caudal appendages, our specimens are quite different from the species usually referred to *Cerapus*, but I have not thought best to make any changes in the nomenclature of any of the species until the discovery of the male shall make it certain whether our specimens belong to the species described by Say." In 1874 a considerable number of specimens were taken, in the towing-net, on the evenings of July 17th and 21st, in Noank Harbor, Connecticut, by Professor Verrill, though I was unable to discover a single specimen in the same locality a few days later. Among these specimens collected by Professor Verrill, there are fortunately an abundance of males which agree with Say's description and figure and leave no doubt whatever that the species is the same as Say's. The following description and figures are taken from these specimens.

The general form of the animal is like *Erichthonius difformis* but much more slender, the body being broad, depressed, very slender, and, in the male, tapering slightly and continuously from the head to the telson. The head is shorter than the first and second segments

of the peræon taken together, and in the male about a fourth as long as the entire peræon, but shorter in the female on account of the elongation of the middle segments of the peræon in that sex. There is a slight dorsal carina on the anterior part of the head, and the anterior margin projects in a slight rostrum in the middle, and at the sides in slightly prominent lobes in which the small black eyes are situated. In the lateral margin below the eye there is a large emargination over the base of the antenna as in the allied genera. In the male the seven segments of the peræon are about equal in length, but in the female the first and last are shorter and the fourth and fifth longer than any of the others, the fourth and fifth being each about twice as long as either the first or last. The epimera are all long and low: those of the first four segments are small and inconspicuous; the fifth (Plate IIa, figure 4, *a*) is much larger and projects in a conspicuous, broad and rounded lobe in front of the articulation of the limb; the sixth and seventh are similar in form but successively much smaller.

In the male, the antennulæ and antennæ are approximately equal in length. The antennulæ are slightly more than half as long as the rest of the animal: the first segment of the peduncle is very stout, but compressed laterally and the lower edge raised into a carina which is prominent near the base, where the dorso-ventral diameter is more than half the length of the segment; the second and third segments are sub-equal in length and diameter and each is slightly longer than the first; the flagellum is about as long as the third segment of the peduncle and is composed of three segments, of which the first is rather longer than the second and third taken together. All the segments are furnished with long setiform hairs below and with much fewer and shorter ones above. The antennæ are a very little shorter than the antennulæ and scarcely, if at all, stouter; the third segment of the peduncle is no longer than broad; the fourth is about as long as the second of the antennula; the fifth is a little longer than the fourth; the flagellum is scarcely as long as the fifth segment of the peduncle and is composed of three segments, of which the first is considerably longer than the second and third together. All the segments beyond the third are furnished with setiform hairs very much as in the antennulæ. In the female, the antennulæ and antennæ are proportionally more than a fourth shorter than in the male, the difference resulting mostly from the shortening of the flagella and the distal segments of the peduncles.

The mandibles are nearly as in the *Erichthonius difformis*. The

palpus is slender, and the third segment is about four times as long as broad and a little shorter, but scarcely longer than, the second. The maxillæ are nearly as in *E. difformis*: in the first pair the inner lobe is small and tipped with one or two setæ only;* in the second pair the two lobes are nearly equally developed. The maxillipeds are essentially as in *E. difformis*.

The gnathopods have essentially the same structure as in *Erichthonius*. The first (Plate IIa, figure 1) are alike in both sexes: the merus is narrow, armed distally with numerous setæ, and its anterior margin articulates with the proximal half of one edge of the triangular carpus; the carpus is nearly as broad as long, the posterior edge is armed with numerous setæ and projects considerably beyond the broad articulation with the propodus; the propodus is as long, but somewhat narrower than the carpus, approximately oval in outline, and thickly armed along the convex posterior edge with setæ and small spines; the dactylus is stout, slightly curved and apparently not capable of complete adduction to the edge of the propodus. The second gnathopods in the female are like the first except that the dactylus is, perhaps, slightly longer. In the adult male, however, the second gnathopods (figure 2) are enormously developed, as in the males of *Erichthonius*. The basis is much stouter but scarcely longer than in the first pair. The ischium and merus are of nearly the same form and size as in the first pair, though the merus is slightly longer. The carpus is more than twice as long and broad as in the first pair: the posterior edge is convex in outline, armed with a few small fasciuli of setæ, and projects distally in a long and stout spiniform tooth; the distal end is very broad, the anterior half only is occupied by the articulation with the propodus, and the edge of the posterior part projects in a prominent obtuse tooth near the base of the propodus, while between this tooth and the great tooth of the posterior angle there is a deep rounded emargination, the border of which is armed with one or two small spines and numerous stout setæ. The propodus is nearly as long as the carpus, about twice as long as broad, slightly curved, and the posterior, or prehen-

* Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 246 (166), and Scandinav. og Arktiske Amphipoder, p. 598, describes the inner lobe of the first maxilla in the Podocerinae, as destitute of setæ ("lamina interiore parvula, ovali, setis destituta"). This is not characteristic of all the species of the group, however, and will not serve as a character for distinguishing *Cerapus* (as here restricted) from the Podocerinae; for Boeck himself, in the latter of the works above quoted, plate 28, figure 3f, figures setæ upon this lobe of the first maxilla of *Cerapus* [*Erichthonius*] *abditus*, and they are certainly present in *Erichthonius difformis*.

sile, edge irregular in outline, minutely dentate and armed with setæ. The dactylus is a little shorter than the propodus, stout, but much narrower at base than the distal end of the propodus, regularly curved, and the prehensile edge minutely serrate and armed with a very few minute setæ.

The first and second peræopods are nearly alike and differ only slightly in the different sexes, and, as in the allied genera, are modified for tube-building, the bases being very large and their interiors almost wholly occupied with the cement-glands. In the male the basis in the first pair (Plate IIa, figure 3) is articulated at the anterior angle of the broad and truncated proximal end, while the posterior angle of the same end is prominent and angular. In the second pair the basis is of similar form, but considerably broader in the middle, and the posterior angle of the distal end does not project and is broadly rounded. In both pairs the ischium is a little longer than broad; the merus is of about the same length but broader than long and with both edges convex in outline; the carpus is scarcely as long as the merus and nearly square; the propodus is narrower but nearly a half longer than the carpus; the dactylus is shorter than the propodus and only slightly curved. In the female the basis in the first pair is proportionally broader than in the male, and the posterior angle of the distal end projects in a rounded lobe separated from the rest of the posterior edge by a marked emargination. In the second pair the basis is only somewhat broader and more oval in outline than in the male.

The third, fourth and fifth peræopods are alike in the two sexes and are reversed and turned upward above the back, with the hooked dactyli directed upward and outward. The third pair (Plate IIa, figure 4, *a*, *b*) are very small, being only a little longer than the basis in the third pair, and in the female scarcely longer than the segment to which they belong. The basis makes more than a third of the entire length, is as long as the ischium and merus together and nearly as broad as long. The ischium is very short and broader than long. The body of the merus is ovoid with the proximal end truncate, and has a long, narrow and spatulate process projecting from the posterior edge near the articulation with the ischium and tipped with one short and three long, plumose setæ. The carpus is articulated upon the middle of the posterior side of the merus and near the base of the spatulate process, to which it approaches in size and form; it is tipped with a single seta and the terminal portion is roughened with very minute scale-like teeth pointing distally. The

propodus is about as long and nearly as wide as the body of the merus, is articulated close to the base of the carpus, and armed with a single minute seta on each edge near the distal end. The dactylus is very short and stout, with the solid chitinous tip turned sharply backward and upward in an acute hook and armed with a sharp tooth on the outside at the point of curvature. The fourth and fifth peræopods are slender and of nearly the same form as in *Erichthonius difformis*. The fourth are about once and a half as long as the third, the basis is much broader than the other segments and about a fourth longer than broad; the ischium is small and nearly square; the merus is twice as long as the ischium and very slightly broader; the carpus is not quite as long as the merus but of about the same width; the propodus is about as long as the merus but much narrower; the dactylus is stout and hooked very much as in the third pair; the distal angles of the merus and carpus are armed with long setæ which are longest and most numerous on the posterior distal angle of the carpus, which projects in a small lobe. The fifth pair are a little longer and proportionately a little more slender than the fourth pair, but do not differ in other respects.

There are, apparently, only three pairs of branchial lamellæ, a single lamella being borne upon each coxa of the first, second and third pairs of peræopods.

Of ovigerous lamellæ there are also only three pairs and these are borne upon the coxæ of the second pair of gnathopods and of the first and second peræopods.

The first segment of the pleon is slightly shorter than the seventh segment of the peræon, and the second and third are successively still shorter. The three pairs of pleopods (Plate IIa, figure 5, *a, b, c*), in marked contrast to those of most Amphipoda, differ remarkably among themselves in the relative proportions of the outer and inner lamellæ, and diminish greatly in size from before backward. This is undoubtedly an adaptation to the position of the animal in its closely fitting tube, with the posterior segments of the pleon bent closely beneath the anterior segments, leaving very little room for the action of the pleopods. In the first pair of pleopods (figure 5, *a*) the base is about as long as the base of the first uropod and more than half as broad as long; the inner lamella is a half longer than the base, narrow, and both margins are furnished with long, plumose setæ; the outer lamella is very little shorter than the inner, narrow distally, but broadly expanding proximally till the breadth is equal to half the length, and then suddenly narrowing to the base; the distal two-

thirds of the inner and the whole of the outer margin are furnished with plumose setæ which are longest at the tip of the lamella and very thickly crowded on the proximal part of the outer margin. The second pair (figure 5, *b*) are very much smaller: the base is little more than half as long as in the first pair; the outer lamella is less than two-thirds as long as in the first pair, ovate, half as broad as long, and both margins are furnished with plumose setæ; the inner lamella is rudimentary, about half as long as the outer and furnished with only two small setæ at the tip and two or three more on the distal part of the inner margin. The third pair (figure 5, *c*) are still smaller: the outer ramus is about two-thirds as long as in the second pair, ovate, and margined with a few plumose setæ distally; the inner is about half as long as the outer, and has only two or three setæ near the tip.

The fourth, fifth and sixth segments of the pleon are much shorter than the first three. As seen from above (Plate IIa, figure 6), the fourth segment is nearly as long as broad; the fifth is a little narrower and not half as long as the fourth, being between three and four times as broad as long; the sixth segment is slightly narrower than the fifth, nearly twice as broad as long, and appears to be partially consolidated with the fifth.

The first pair of uropods (Plate IIa, figure 6) are well developed: the bases are stout and reach to the base of the telson; the outer ramus is narrow, shorter than the peduncle, minutely serrate and sparsely setigerous along the outer edge, and tipped with a slender spine; the inner ramus is smaller than the outer, about three-fourths as long, and tipped with a spine, but the edges unarmed. The second uropods are small, slender and uniramous: the base is about as stout as the outer ramus of the first pair, does not quite reach the base of the telson, and is unarmed; the terminal segment is very short, stout and hooked, and very similar in structure to the terminal segments of the third uropods and the dactyli of the third, fourth and fifth peræopods. The third uropods are like the second, but the bases are much stouter and each is armed with a short seta on the inner edge. The telson is about twice as broad as long and bilobed at the extremity, the lobes being broadly rounded and armed with two or three transverse rows of hooked spines above.

In life, a large portion of the animal appears almost black from the crowding together of numerous specks of very dark purplish pigment. The first segment of the peduncle of the antennula is nearly all colored in this way and there is a broad band of the same character

at the distal end of each of the other segments of the peduncle. The proximal segments of the antenna are also dark-colored, and there is a broad band of color at the distal end of the fourth segment. Other parts of the peduncles of the antennulæ and antennæ are semi-translucent, and so are the flagella. The head and the whole anterior and middle portions of the body of the animal and the epimera are more or less colored in the same way, as are the gnathopods and the bases of the first and second peræopods; but the distal portions of these peræopods, the whole of the third, fourth and fifth pairs, and the caudal appendages are semi-translucent and nearly or quite devoid of pigment.

Two adult specimens give the following measurements:

	Male.	Female.
Length from front of head to tip of telson,	4.2 ^{mm}	4.4 ^{mm}
Length from front of head to second segment of pleon in natural position of rest,	3.5	3.6
Length of antennula,	2.4	1.7
Length of tube,	5.4	5.5
Diameter of tube at middle,	.80	.85

In the largest specimens seen the tubes are about 7^{mm} long and 0.9^{mm} in diameter, while in the smallest they are only 2^{mm} long and 0.45^{mm} in diameter.

The tubes of all the specimens seen are black externally, thin, and very regularly cylindrical, except that they are usually slightly enlarged at one or at both ends. Within they are smoothly lined with a layer of cement, while externally they are covered, to a great extent at least, with minute, elongated pellets, apparently the excrement of the animal,* arranged transversely to the tube and closely

* In several allied species of Amphipoda, the excrement enters largely into the composition of the tube. In 1874 I watched carefully the process of constructing the tubes in several species of Amphipoda. *Microdeutopus grandimanus* (*M. minax* Smith) was a particularly favorable subject for observation. When captured and placed in a small zoophyte trough with small, branching algæ, the individuals almost always proceeded at once to construct a tube, and could very readily be observed under the microscope. A few slender branches of the algæ were pulled toward each other by means of the antennæ and gnathopods, and fastened by threads of cement spun from branch to branch by the first and second pairs of peræopods. The branches were not usually at once brought near enough together to serve as the frame-work of the tube, but were gradually brought together by pulling them in and fastening them a little at a time, until they were brought into the proper position, where they were firmly held by means of a thick net-work of fine threads of cement spun from branch to branch. After the tube had assumed very nearly its completed form, it was still usually nothing but a transparent net-work of cement threads woven among the

crowded together; there appear, however, to be other materials, probably minute fragments of algæ, hydroids, etc., mixed with the pellets. The tube is apparently never attached, but is carried about by the animal, very much after the manner of the larvæ of some species of Phryganeidæ, as described by Say. It is very difficult to force the living animal from its tube, and it probably never quits the tube voluntarily. The ordinary position of the animal when at rest is with the head only protruding from one end of the tube, the antennulæ stretched out in front and diverging at about a right angle, while the antennæ are held out each side at right angles to the tube. The antennulæ and antennæ are the only appendages which are ordinarily used in locomotion, and by means of these alone the animal appears to move about with its tube with the same ease and rapidity as the species of *Podocerus* and *Corophium* do when unencumbered.

As noticed by Say, the animal turns about within its tube very readily, and uses either end of it indifferently as the front. If the tube catch in any way while the animal is moving about, or if it be held fast by forceps, the head is protruded first from one and then from the other end of the tube in quick succession, and the antennulæ and antennæ are thrust along the outside of the tube to discover the

branches of the alga, though occasionally a branch of the alga was bitten off and added to the frame-work; but very soon the animal began to work bits of excrement and bits of alga into the net. In this case the pellets of excrement, as passed, were taken in the gnathopods and maxillipeds, and apparently also by the maxillæ and mandibles, and broken into minute fragments and worked through the web, upon the outside of which they seemed to adhere partially by the viscosity of the cement threads and partially by the tangle of threads over them. Excrement and bits of alga were thus worked into the wall of the tube until the whole animal was protected from view, while, during the whole process, the spinning of cement over the inside of the tube was kept up. When spinning the cement threads within the tube, the animal was held in place on the ventral side by the second pair of gnathopods and the caudal appendages, the latter being curved beneath the anterior portion of the pleon, and on the dorsal side by the third, fourth and fifth pairs of peræopods extended and turned up over the back, with the dactyli turned outward into the web. The spinning was done wholly with the first and second peræopods, the tips of which were touched from point to point over the inside of the skeleton tube in a way that recalled strongly the movements of the hands in playing upon a piano. The cement adhered at once at the points touched and spun out between them in uniform delicate threads. The threads seemed to harden very quickly after they were spun and did not seem, even from the first, to adhere to the animal itself. In one case in which the entire construction of the tube was watched, the work was apparently very nearly or quite completed in little more than half an hour. In a species of *Amphithoë*, in which the construction of the tube was watched, the process was very similar, though less cement and more foreign material seemed to enter into the structure.

obstruction. While thus held fast, fully half the body is often protruded from the tube. In turning about within the tube, the terminal segments of the pleon are thrust forward beneath the anterior segments and the peræon pulled back over them, and then the peræon is folded back upon itself in the same way, but the antennulæ, antennæ and head are never first bent beneath the peræon. The structure of the telson, second and third uropods, and of a part of the peræopods is well adapted to the performing of this evolution; the hooks of the second and third uropods and of the telson holding the tail fast to the side of the tube, while the third, fourth and fifth peræopods, holding on with their opposing hooked tips, pull the posterior part of the peræon back over the pleon, and then the first gnathopods help to complete the evolution.

The tubes are usually kept quite free from foreign growths, but among the specimens taken in 1874, there are two individuals in tubes to which are attached the egg capsules of *Tritia trivittata*.

I was not able to discover how the diameter of the tube is enlarged to accommodate the growing animal, but it is probably accomplished by building on a larger portion at one end and pulling to pieces the other end until the whole tube is reconstructed.

As the preceding description shows, this type species of the genus *Cerapus* is generically distinct from the species referred to that genus in recent works, and for which Milne-Edwards' genus *Eriethonius* may properly be retained as explained further on. Say's species is apparently not congeneric with any described species and the genus cannot properly be placed in any of the numerous subfamilies defined by Boeck, though it is probably most nearly allied to his Podocerinæ. I therefore propose the following new subfamily to be placed next Podocerinæ.

CERAPINÆ.

The single known genus differs from the Podocerinæ and allied groups in the following characters. There are only three pairs of branchial lamellæ, which are borne on the third, fourth and fifth segments of the peræon, and only three pairs of ovigerous lamellæ, which are borne on the second, third and fourth segments. The second and third pleopods are much smaller than the first, and their inner lamellæ are rudimentary or very small. The second and third uropods are uniramous and nearly alike, the distal segment in each being short and terminating in a hooked point.

The only known species inhabits unattached, portable tubes, and, as in many allied genera, has large cement glands in the bases of the first and second peræopods.

Cerapus Say.

- Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 49, 1817 (*tubularis* the only species.)
 Desmarest, Dictionnaire Sci. nat., xxviii, p. 358, 1823 (=Say).
 Latreille, in Cuvier, Règne animal, iv, p. 122, 1829 (=Say).
 Milne-Edwards, Ann. Sci. nat., Paris, xx, p. 383, 1830 (=Say); Hist. nat. Crust., iii, p. 60, 1840 (in part).
 Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309, 1852 (=Say); Crust. United States Expl. Expd., p. 832, 1853 (=Say).
 Bate, Catalogue Amphip. Crust. British Mus., p. 262, 1860 (in part).

Cerapus tubularis Say.

- Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 50, pl. 4, figs. 7-9, 1817.
 Desmarest, Dictionnaire Sci. nat., xxviii, p. 358, pl. 46, figs. 2a-2e (after Say), 1823 (=Say); Consid. génér. Crust., p. 271, pl. 46, figs. 2a-2e (=last), 1825 (=Say).
 Audouin, Précis d'Entomologie, pl. 28, figs. 5-7 (after Say), 1828 (=Say).
 Guérin, Iconographie du Règne animal, Crust., pl. 27, fig. 4, (after Say).
 Milne-Edwards, Règne animal de Cuvier, 3^{me} édit., pl. 61, fig. 5-5c (after Say), 1837; Hist. nat. Crust., iii, p. 60, pl. 29, fig. 15 (after Say), 1840 (=Say).
 Bate, Catalogue Amphip. Crust. British Mus., p. 262, pl. 45, fig. 1 (after Say), 1862 (=Say).
 Smith, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 565 (271), 1874.

PLATE IIa.

Great Egg-Harbor, New Jersey (Say). Vineyard Sound, among masses of a large compound ascidian (*Amouroucium pellucidum*), in 8 to 10 fathoms, off Nobska Point, June 27, 1871; several females, some of them carrying eggs. Vineyard Sound, 1875; one specimen. Taken in the towing net, among eel-grass (*Zostera*), in Noank Harbor, Connecticut, July 17 and 21, 1874 (A. E. Verrill); males, females, and young, many of the females carrying eggs.

The genus *Cerapus* being restricted to the type species and removed from the Podocerinæ, as above, Milne-Edwards' *Erichthonius* appears to be the proper name to restore and retain for the group of species referred to *Cerapus* by recent authors.

Erichthonius.

- Erichthonius* M.-Edwards, Ann. Sci. nat., Paris, xx, p. 382, 1830 (*difformis* the only species); Hist. nat. Crust., iii, p. 59, 1840 (*difformis* only).
 Dana, Amer. Jour. Sci., II, viii, p. 138, 1849, and xiv, p. 309, 1852; U. S. Expl. Expd., Crust., p. 832, 1853 (*Erichthonius*).

Erichthonius—(continued).

- Bate, Report British Assoc. Adv. Sci., 1855, p. 59, 1856 (*Erichthonius*); Ann. Mag. Nat. Hist., II, xix, 149 (17), 1857.
- White, Popular Hist. British Crust., p. 196, 1857.
- Liljeberg, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 131.
- Costa, Amphipodi Napoli, Mem. Accad. Sci. Napoli, i, pp. 175, 227, 1856.
- Bruzelius, Scandinav. Amphipoda Gammaridea (Vetenskaps-Akad. Handlingar, Stockholm, iii), p. 17, 1859 (*Erichthonius*).
- Cerapodina* M.-Edwards, Hist. nat. Crust., iii, p. 62, 1840 (*abditus* (= *Cerapus abditus* Templeton) the only species).
- Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309, 1852; U. S. Expl. Expd., Crust., p. 832, 1853.
- Podocerus* Kröyer, Naturh. Tidsskrift, iv, p. 163, 1840 (in part).
- Dercythoe* Dana, Amer. Jour. Sci., II, xiv, p. 313, 1852; U. S. Expl. Expd., Crust., p. 911, 1853.
- Pyctilus* Dana, Amer. Jour. Sci., II, xiv, p. 313, 1852; U. S. Expl. Expd., Crust., p. 911, 1853.
- Cerapus* Bate, Catalogue Amphip. Crust. British Museum, p. 262, 1860 (in part).
- Bate and Westwood, British Sessile-eyed Crust., i, p. 452, 1863.
- Czerniavski, Materialia ad Zoographiam Ponticam comparatam, p. 97, 1868.
- Boeck, Christiania Videnskabs-Selskabs Forhandlingar, 1870, p. 250 (170); Scandinav. og arktiske Amphip., p. 611, 1876.

The synonymy of *E. difformis*, the type of the genus, is apparently still in confusion, and as it is a common species upon the coast of northern New England, I subjoin the following account of it :

Erichthonius difformis Milne-Edwards.

- Erichthonius difformis* M.-Edwards, Ann. Sci. nat., Paris, xx, p. 382, 1830; Hist. nat. Crust., iii, p. 60, pl. 29, figs. 12, 13, 1840.
- Liljeberg, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 129.
- ? Costa, Amphipodi Napoli, Mem. Accad. Sci. Napoli, i, p. 228, 1856.
- Bruzilius, Scandinav. Amphipoda Gammaridea (Vetenskaps-Akad. Handlingar, Stockholm, iii), p. 17, 1859 (*Erichthonius*).
- Goes, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1865, p. 552 (*Erichthonius*).
- Podocerus Leachii* Kröyer, Naturh. Tidsskrift, iv, p. 163, 1840 ("Femina hujus speciei forma pedum secundi paris Podocerus est, mas vero Erichthonius").
- Cerapus rubricornis* Stimpson, Inverteb. Grand Manan, p. 46, pl. 3, fig. 33 (caudal appendages), 1853.
- Bate, Catalogue Amphip. Crust., British Museum, p. 265, pl. 45, fig. 4 (young ♂), 1862 (Bay of Fundy).
- Packard, Memoirs Boston Soc. Nat. Hist., i, p. 297, 1867 (*C. rubiformis*).
- Smith, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 565 (271), pl. 4, fig. 18, 1874.
- Smith and Harger, Trans. Conn. Acad., iii, pp. 5, 19, 1874.
- Podocerus punctatus* Bate, Ann. Mag. Nat. Hist., II, xix, p. 148 (17), 1857 ("*P. punctatus* (Edwards, MS. Brit. Mus.)").

Erichthonius difformis Milne-Edwards—(continued).

Dercothoe (*Cerapus*) *punctatus* Bate, Catalogue Amphip. Crust. British Museum, p. 260, p. 44, fig. 10, 1862 (♀).

Dercothoe (*Cerapus* ♀) *punctatus* Bate and Westwood, British Sessile-eyed Crust., i, p. 461 (fig.), 1863 (♀). ["Milne-Edwards, MS. in Brit. Mus." is quoted as authority for the name as here used.]

? Czerniavski, Materialia ad Zoographiam Ponticam comparatam; p. 96, 1868.

Cerapus difformis Bate, Catalogue Amphip. Crust. British Museum, p. 265, pl. 45, fig. 5, 1862.

Bate and Westwood, op. cit., p. 457 (figs.), 1863.

Norman, Report British Assoc. Adv. Sci., 1868, p. 283, 1869.

Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872-3, Nordsee, p. 278, 1875.

Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 250 (170); Scandinav. og arktiske Amphip., p. 615, 1876.

Meinert, Naturh. Tidsskrift, III, xi, p. 157, 1877.

Cerapus Leachii Bate, Catalogue Amphip. Crust. British Museum, p. 268, 1862 (= Kröyer).

Cerapus Hunteri Bate, Catalogue Amphip. Crust. British Museum, p. 264, pl. 45, fig. 3, 1862 (habitat unknown).

Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 252 (172), 1871 (Scandinavia); Scandinav. og arktiske Amphip., p. 618, pl. 28, fig. 5, 1876.

Vineyard Sound!, 1871, not common. Off Cape Cod!, 29 fathoms, 1879. Stellwagen's Bank! and Jeffrey's Ledge!, 1873. George's Banks!, 50 fathoms, sand and shells, and 45 fathoms, coarse sand, 1872. Casco Bay!, 9 to 34 fathoms, 1873; common. Bay of Fundy!, low-water mark to 50 fathoms, abundant, especially on hard bottoms, 1868, 1870, 1872, 1876; and, in 1872, off Head Harbor, 77 fathoms, mud and stones; and off White Head, Grand Menan, 97 to 105 fathoms, gravel and stones. Halifax, Nova Scotia!, 16 fathoms, rocky, 1877. Straits of Belle Isle, Labrador, (Packard). Spitzbergen, (Goës). Scandinavia, (Kröyer, Liljeborg, Boeck, et al.) British Isles!, (Norman). Brittany, France, (M.-Edwards). It is reported from the Mediterranean by Costa, and from the Black Sea by Czerniavski, (as Bate's *Dercothoe* (*Cerapus* ♀) *punctatus*), but these identifications are, perhaps, erroneous.

The form of the second pair of gnathopods of the adult male varies very much in different specimens. When farthest differentiated from the form characteristic of the female and young, the carpus is triangular, and the spine of the inferior margin very long and separated from the propodal articulation by a deep, triangular sinus, while the propodus is slender, nearly cylindrical, and without prominences on the inferior edge. This is the form which I have figured in the work above referred to, and is apparently very near that figured by Milne-

Edwards as the original *E. difformis*. It is probably the form characteristic of the old males, though the individuals are often smaller than those with the second gnathopods in the less differentiated condition, in which the body of the carpus is more nearly quadrangular in outline, the spine arising near the propodal articulation, and the propodus shorter and stouter than in the other form and with two conspicuous prominences on the inferior edge. This is the form described as *Cerapus Hunteri*, by Bate and by Boeck. In the large series of specimens before me, there is every gradation between these two forms, and between the latter and the female. In one case, an individual had one of the second pair of gnathopods in the most differentiated form, while the other was somewhat smaller and in the less differentiated form—evidently having been lost and reproduced. The only European specimens which I have examined were received from the Rev. Mr. Norman, and are from the Northumberland coast, England, and among these all the adult males agree better with the *Hunteri* than with the more differentiated form.

The habit of the animal and the character of the tubes are well described by Stimpson. In life, the proximal parts of the flagella of the antennulæ and antennæ are bright red, and the color usually remains for some time in specimens preserved in alcohol.

The genus Unciola.

Unciola Say.

Unciola Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 388, 1818 (*irrorata* the only sp.)

Milne-Edwards, Ann. Sci. nat., Paris, xx, p. 383, 1830 (= Say).

Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309 (> *Glaucanome*); U. S. Expl. Expd. Crust., p. 832, 1853.

Bate, Catalogue Amphip. Crust. British Museum, p. 279, 1862 (> *Glaucanome*).

Glaucanome Krøyer, Naturh. Tidsskrift, II, i, pp. 491–501 (*leucopis* the only sp.)

Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 259 (179); Scandinavianiske og arktiske Amphip., p. 636, 1876.

"*Cyrtopium* Danielssen, Beretning om en zoologisk Reise, 1857, Nyt Magaz. Naturvidensk., xi, p. 8, 1861," (Boeck).

Krøyer's name *Glaucanome* is not only more recent than Say's *Unciola*, but it had been used at least twice before Krøyer employed it, once in mollusks and once in polyps.

Unciola irrorata Say.

Unciola irrorata Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 389, 1818.

Milne-Edwards, Hist. nat. Crust., iii, p. 69, 1840 (= Say).

Stimpson, Marine Invertebrata of Grand Manan, p. 45, 1853.

Unciola irrorata Say—(continued).

Bate, Catalogue Amphip. Crust. British Mus., p. 279, 1862 (description compiled from Say).

Verrill, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 340 (46), 1874.

Smith, in Verrill, op. cit., p. 567 (273), pl. 4. fig. 19, 1874.

Glaucnome leucopis Kröyer, Naturh. Tidsskrift, II, i, p. 491, pl. 7, fig. 2, 1845; in Gaimard, Voyage en Scandinavie, Crust., pl. 19, fig. 1, 1849.

Goes, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1865, p. 533.

Boeck, Christiania Videnskabs-Selskabs Forhandlingar, 1870, p. 259 (179); Scandinaviske og arktiske Amphip., p. 636, 1876.

G. O. Sars, Archiv Mathem. Naturvid., Kristiania, ii, p. 360, 1876.

Norman, Proc. Royal Soc. London, xxv, p. 208, 1876.

Unciola leucopes [-is] Bate, Catalogue Amphip. Crust. British Mus., p. 279, pl. 47, fig. 3, 1862 (description and fig. after Kröyer).

"*Cyrrhopium Darwini* Danielssen, Beretning om en Zoologisk Reise, p. 8," (Boeck.)

This is one of the most abundant of all New England Amphipoda, being found in greater or less abundance in a very large proportion of the dredgings from the shallowest water down, at least, to 400 fathoms, and from all kinds of bottom, though in less abundance in mud than among sand and shells. I have collected it at Great Egg Harbor, New Jersey, where Say's original specimens were obtained, and at various points along the New England coast from Connecticut to the Bay of Fundy. It was dredged by Mr. Harger and myself while on board the Bache in 1872, on St. George's Banks, and in 430 fathoms east of these Banks, north latitude $41^{\circ} 25'$, west longitude $65^{\circ} 42.3'$. It was obtained in abundance in and off Halifax Harbor, Nova Scotia, by the U. S. Fish Commission, in 1877; and I have examined specimens dredged in the Gulf of St. Lawrence by Mr. Whiteaves, and on the coast of Labrador by Prof. Packard. Kröyer's specimens of *Glaucnome leucopis* were from Greenland, and Norman reports it, under the same name, as taken in 100 fathoms in Davis Strait by the Valorous Expedition. Boeck records the same species from Spitzbergen and Norway, and G. O. Sars reports numerous specimens, obtained by the Norwegian Expedition in 1876, from 412, 417, and 520 fathoms, in the area of cold water off the west coast of Norway.

In life, the body of the animal above is usually bright red more or less mottled, especially upon the sides, with white; the outer surfaces of the larger gnathopods are broadly marked with bright red, and the antennulæ and antennæ are annulated with the same color. In some individuals, especially from muddy bottoms, the red is nearly all wanting; in others the red appears, to the naked eye, to

be uniformly diffused, giving the animal a pale red tint; in still others the red is largely replaced by brown. The animal apparently does not construct tubes for itself, though often found in the tubes of other Amphipoda and in the tubes of Annelida. In the Bay of Fundy I have found it abundantly in small holes in sandy mud near low-water mark.

The species described by Say and that described by Kröyer are not only congeneric, as suggested by Dana, but apparently specifically identical. Specimens from the coast of New England agree in every particular with Boeck's descriptions and with Kröyer's descriptions and figures, except in the details referred to beyond. Say describes the second gnathopods as "adactyle" and the third pair of uropods as simple, depressed and concealed by the others, and he failed to distinguish the very short sixth segment of the pleon from the telson, describing the two together as the terminal segment of the "tail." These are very natural errors, considering the minuteness of the appendages. In all other respects Say's description is correct. Kröyer, on the other hand, incorrectly describes and figures the third uropods as bi-ramus, mistaking the terminal lobe on the inner side of the base for a second ramus. Boeck, who had access to Kröyer's types, states that Kröyer's figure of the third uropod is incorrect but does not mention the corresponding error in the description of the species. White (Catalogue Crust. British Museum, p. 90, 1847) records, as in the British Museum, specimens of *Unciola irrorata* received from Say; Bate, however, (Catalogue Amphip. Crust. British Museum, p. 279, 1862) states that he has seen no specimens, but refers Kröyer's species to *Unciola*, although he in part misquotes and in part misunderstands Say's generic description. Bate appears to have drawn his description of Kröyer's species from the original figure and generic diagnosis and not from the very full description of the species, for he says that no reference to the telson is made either by Say or by Kröyer and that it is not impossible that the genus is synonymous with "*Microdentopus*," although the telson is described by Kröyer, in the description just referred to, and is figured in the Voyage en Scandinavie.

The genus Lepidactylis.

It has long been known to me that Say's genus *Lepidactylis* was congeneric with *Sulcator* of Bate, as suggested by Dana in 1852; but Bate's description and figures not appearing fully to warrant the assumption of the identity of the European and American species,

and not at the time having access to the figures of Slabber's *Oniscus arenarius*, upon which Latreille's genus *Pterygocera* was based, I, in 1874, recorded, in the Report on the Invertebrate Animals of Vineyard Sound, Say's species under his generic and specific names and made no attempt to straighten the generic or specific synonymy. A richly illustrated memoir, by Carl Bovallius, on the European *Sulcator* (*Pterygocera*), and British specimens received from the Rev. A. M. Norman, have recently afforded an opportunity for comparing the American and European forms. On comparing New England specimens of Say's species with Bovallius' numerous and excellent figures, and with the British specimens, I can find no characters by which the American can be distinguished from the European form. Say's generic name should therefore be retained in place of Latreille's *Pterygocera*, though Slabber's specific name (fortunately a more appropriate designation) takes precedence of Say's *dytiscus*. The following synonymy of the genus and species sufficiently explains these changes in nomenclature. Except under *Lepidactylis*, I give only the earliest reference under each name, as this part of the synonymy is pretty fully given by Bovallius.

PTERYGOCERINÆ Bovallius.

Lepidactylis Say.

- Oniscus* Slabber, *Natuurkundige Verlustigingen*, p. 92, pl. 11, figs. 3, 4, 1778.
- Lepidactylis* Say, *Jour. Acad. Nat. Sci. Philadelphia*, i, p. 379, 1818 (*dytiscus* the only species).
- Desmarest, *Dictionnaire Sci. nat.*, xxviii, p. 358, 1823 (= Say); *Consid. génér. Crust.*, p. 272, 1825 (= Say).
- M.-Edwards, *Ann. Sci. nat.*, Paris, xx, p. 397, 1830 (= Say).
- Dana, *Amer. Jour. Sci.*, II, viii, p. 138, 1849, and xiv, p. 313, 1852 (> *Bellia* Bate); *U. S. Expl. Expd.*, *Crust.*, p. 912, 1853.
- Bate, *Catalogue Amphip. Crust. British Museum*, p. 111, 1862 (= Say).
- Pterygocera* Latreille, *Encyclopédie méthodique*, x, pp. 121, 236, 1825 (teste Bovallius); in Cuvier, *Règne animal*, 2^e édit., iv, p. 124, 1829.
- Bellia* Bate, *Ann. Mag. Nat. Hist.*, II, vii, p. 318, 1851.
- Sulcator* Bate, *Ann. Mag. Nat. Hist.*, II, xiii, p. 504, 1854 (in place of *Bellia* preoccupied).

According to Bovallius, Statius Müller, in a German translation of Slabber's work above referred to, in 1781 proposed the generic name *Haustorius* for Slabber's species; but, as Bovallius says, the name is an adjective, has never come into use, and is properly rejected.

Lepidactylis arenarius.

Oniscus arenatius Slabber, op. cit., 1778 (corrected to *arenarius* in errata).

Lepidactylis dytiscus Say, loc. cit., p. 380, 1818.

Bate, Catalogue Amphip. Crust. British Museum, p. 112, 1862 (= Say).

Smith, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 556 (262), 1874.

Pterygocera arenaria Latreille, Encyclopédie méthodique, 1825 (based on Slabber's species; teste Bovallius).

Bovallius, Notes on *Pterygocera arenaria* Slabber (Bihang till Svenska Vetenskaps-Akad. Handlingar, iv, no. 8), pp. 1-27, pls. 1-4, 1878.

Bellia arenaria Bate, Ann. Mag. Nat. Hist., II, vii, p. 318, pl. 9, figs. 1-8, 1851 (gen. et sp. nov.)

Sulcator arenarius Bate, Ann. Mag. Nat. Hist., II, xiii, p. 504, 1854.

Sulcator arenatius Boeck, Christiania Videnskabs-Selskabs Forhandling, 1870, p. 137 (57).

Coast of Georgia (Say). New Haven !, Connecticut, sandy shores, at low water, not rare, and also dredged in shallow water (A. E. Verrill, S. I. Smith, et al.) Vineyard Sound !, 5 to 10 fathoms, sandy and shelly bottoms, 1871, 1875. Smith's Point !, Beverly, Massachusetts, sand, at low water, August 25, 1878 (J. H. Emerton). These specimens collected by Mr. Emerton are the only ones I have seen from north of Cape Cod. On the European coast, it is reported from the British Isles ! (Norman, Bate), the coast of Holland (Slabber), and Scandinavia (Boeck, Bovallius).

EXPLANATION OF PLATE IIa.

Cerapus tubularis.

All the figures are enlarged seventy diameters, except 4, *b*, which is enlarged one hundred and forty diameters.

FIGURE 1.—First gnathopod and epimeron of the right side of an adult male.

FIGURE 2.—Second gnathopod and epimeron of the right side of the same specimen.

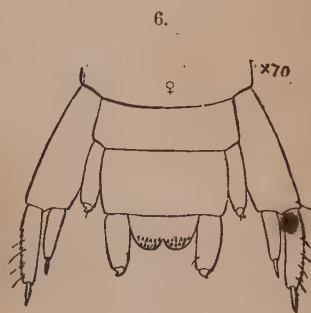
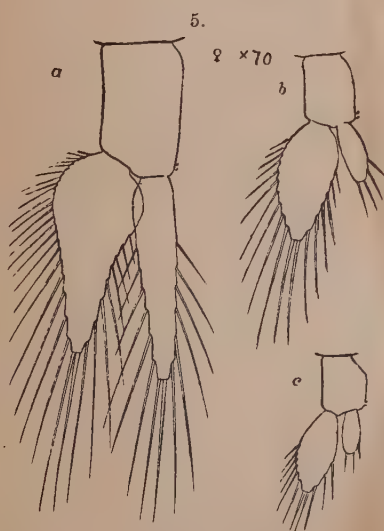
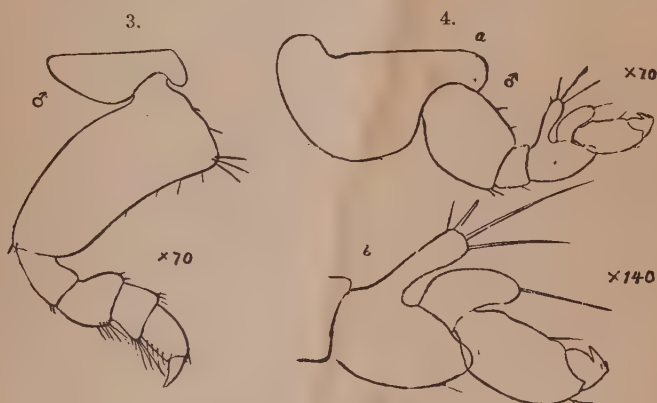
FIGURE 3.—First peræopod and epimeron of the right side of the same specimen.

FIGURE 4.—*a*, Third peræopod and epimeron of the right side of the same specimen ;
b, distal portion of the same still more enlarged.

FIGURE 5.—Pleopods of the right side of an adult female: *a*, first; *b*, second;
c, third.

FIGURE 6.—Extremity of the pleon of the same specimen, dorsal view, showing uropods and telson.

NEW HAVEN, July 1, 1880.





NOTES ON NORTH AMERICAN DECAPODA. BY J. S. KINGSLEY.

The specimens upon which this paper is based are to be found in the Museum of the Peabody Academy of Science at Salem, Mass.

MAIOIDEA.

Family MAIIDAE. Sub-Family PISINAE.

Genus MICROPHRYS M. Edw., (MILNIA Stm.).

Microphrys error sp. n.

Microphrys depressa Streets and Kingsley, Bulletin Essex Institute, IX, 103 (1877). (*non Fisheria depressa* Lockington.)

A further examination of the specimen sent by Mr. Lockington as a type of his *Fisheria depressa* convinces me that it is not the species described by him under that name. I regard it as belonging to the genus *Microphrys* (Milnia Stm.) but it differs from Stimpson's diagnosis of the genus in the following respects. The orbits have a distinct fissure above, and no trace of a second; the basal joint of the antenna has one strong spine at the external angle, but no second smaller one. The external maxillipeds and dactyli of the ambulatory feet strongly resemble those of *M. bicornutus*. Should it be thought that these characters of antennae and orbits are of generic value, I would propose the generic name *Eumilnia*.

In the single specimen (a male) before me, I note the following characters.

Carapax depressed, regions very distinct and protuberant (more so than in *M. bicornutus*), hairy and armed with smaller and more acute tubercles than in that species. There are two strong spines on the posterior portion of the branchial region, near together and placed further back than the single one in *M. bicornutus*. A transverse crowded row of spiniform tubercles crosses the intestinal region. Margin of the hepatic region with an imbricated process, and on the branchial region an imbricated laminiiform ridge, beneath the anterior portion of which is a strong styliform tooth. Rostrum with the horns straight, divergent, and not at all incurved at the tips. Orbits with a strong, prominent, acute tooth at the inner angle and a single distinct fissure above. Basal joint of antenna with a single spine at the external distal angle, which is longer and more acute than in *M. bicornutus*. Chelipeds moderate; meros with one or two teeth at the

proximal portion above, distally with a laminiform crest; carpus externally tuberculate; hand compressed, fingers widely gaping, distally toothed, pollex bent downwards and then upwards, dactylus regularly curved, with a tooth on the occludent margin near the base.

Remaining feet slender, cylindrical, decreasing in length backward; meros and carpus of the first pair of ambulatory feet, each with a long, slender, acute spine above, near the distal extremities; propodal joints of all the feet with a rounded laminiform process for the articulation of the dactyli; dactyli strongly curved, pectino-denticulate beneath.

One male in the Museum of the Peabody Academy of Science from Lower California gives the following measurements.

Length of carapax, 17.5 mm.; breadth, 13.5 mm.; ratio, 1: 0.72.

This species differs from *M. aculeatus* as shown in Bell's description and figure (Trans. Zool. Soc., London, II, 50, pl. IX, f. 7.) in having many tubercles on the cardiac region, and only two spines on each branchial region (*M. aculeatus* has four), in wanting the spines on the meros of third pair of feet, and from both *M. aculeatus* and *M. bicornutus* in having the horns of the rostrum straight and not incurved.

Genus *ANAPTYCHUS* Stm. (ALA Lockington).

Anaptychus cornutus Stm.

Anaptychus cornutus Stimpson, Annals N. Y. Lyceum, VII, 184, pl. II, f. 1, (1859); Streets and Kingsley, l. c., IX, 105, (1877). *Ala spinosa* Lockington, Proceedings of the California Academy of Science, VII, 66, (1877, extras issued in 1876).

In addition to the characters given by Stimpson, the following may be observed in the specimen sent by Mr. Lockington from the Gulf of California as the type of his *Ala spinosa*. The median portion of the posterior crest six lobed; there are nine depressed tubercles on the gastric region, and in our specimen the first tooth of the antero-lateral margin is narrower and more slender than it is represented in Stimpson's figure.

Length of carapax, 19 mm.; greatest breadth, 24 mm.; ratio, 1: 1.24.

Sub-Family MITHRACINAE.

Genus *MITHRACULUS* White.

Mithraculus areolatus Streets and Kingsley.

Mithrax areolatus Lockington, l. c. VII, 71, (1876). *Mithraculus areolatus* Streets and Kingsley, l. c. IX, 104, (1817).

Carapax naked, depressed, deeply areolate, areolations less broken than in *M. sculptus*, punctate, a transverse of five tubercles on the gastric region and two more acute ones on the outer posterior portion of each branchial region, two prominent tubercles at the base of the rostrum, one on each side of the median line. Rostrum short, bifid, outer margins of horns arcuate, inner straight. Orbits with one distinct fissure above, inner angle prominent, rounded; outer also rounded but less prominent; external hiatus a rounded opening. Antero-lateral margin with three teeth, besides the external angle of the orbit, first and second teeth stout, prominent, obtuse, the second the larger; third tooth slender, acute, hooked forward; a small acute tooth on the postero-lateral margin behind the lateral angle. A tubercle on the subhepatic region beneath the first tooth of the antero-lateral margin. An oblique row of rounded tubercles running backward from the palatal region. Basal joint of antenna with two short blunt teeth. Chelipeds small; posterior margin of meros four toothed, upper surface with one tooth, inner margin with a single rounded tubercle; carpus prominently tuberculate; hand smooth, inflated, cristate above at the base, a small depressed tubercle on the outer surface at the articulation with the carpus; fingers moderately gaping, denticulated at the extremity, a basal tooth on the dactylus in both sexes, but the larger in the male. Ambulatory feet with spinous tubercles on the basal joints, becoming obsolete on the distal ones; dactyli strongly arcuate. Specimens from the Gulf of California sent by Mr. Lockington have the following dimensions.

Length of carapax, ♂, 11 mm., ♀, 11.7 mm.; breadth, ♂, 13.5 mm., ♀, 15 mm.; ratio, ♂, 1:1.23, ♀, 1:1.28.

This species differs from *M. cinctimanus*, *denticulatus*, *hirsutipes* (sp.n.) and *minutus* (*Mithrax minutus* Saussure) in having but three teeth on the antero-lateral margin; from *M. denticulatus*, *ruber*, *hirsutipes* and *sculptus* in the presence of a basal tooth on the dactylus of the chelipeds; from *M. sculptus*, *cinctimanus* and *coronatus* in having the ridge running backward from the palatal region tuberculate; from *M. nodosus* in having the orbit fissured above, and in the more acute lateral tooth. It appears to be most closely allied to *M. ruber* but lacks the sinuous character of the anterior margin of the external maxillipeds, found in that species.

***Mithraculus hirsutipes* sp. n.**

Carapax smooth, naked, sculptured, with four tubercles on the

externo-posterior portion of each branchial region, and a single one at the base of each horn of the rostrum. Rostrum short, bilobed; orbits with a single fissure above, below with a deep groove externally and a fissure further in. Antero-lateral margin with four teeth, besides the external orbital angle, the first rather obtuse, the rest acute, second the largest, the last the most acute and strongly hooked forward; behind this last is a small tooth on the postero-lateral margin; a small tubercle on the subhepatic region a little in advance of the first antero-lateral tooth. The oblique ridge running backward from the palatal region is tuberculate. Basal joint of antenna with a short obtuse tooth, the two last joints of the peduncle with a stiff bristle on the inner distal angle. Chelipeds moderate, meros with spiniform tubercles above, inner margin with two spines near the distal extremity; carpus and hand smooth, the latter compressed, the fingers not so long as the palm, not denticulate, and with no tooth on the dactylus at the base. Remaining feet stout; meral, carpal and propodal joints armed with spiniform tubercles, and together with the basal portion of the dactyli, covered with long, stout hairs; distal portion of dactyli naked, strongly curved. Two specimens were brought from Key West, Fla., by Dr. A. S. Packard, Jr.

Length of carapax, 14 mm.; breadth, 17 mm.; ratio, 1: 1.21.

It differs from *M. nodosus*, *coronatus*, *areolatus*, *ruber* and *sculptus* in having the antero-lateral margin four-toothed; from *M. coronatus* in its narrower carapax and rounder outline; from *M. cinctimanus* in the broader carapax, the acute antero-lateral teeth and the absence of teeth on the fingers of the chelipeds; from *M. minutus* and *denticulatus* in the same character of the fingers.

Genus MITHRAX Leach, Stimpson.

Mithrax trispinosus sp. n.

Carapax depressed, pubescent, about as long as broad, surface granulate, with scattered tubercles. Of these there is one on each side of the median line near the base of the rostrum, three on each hepatic region, four on each branchial region near the base of the second tooth, and others posterior to these, a transverse row of four prominent ones, with smaller ones on each side, near the posterior margin. Rostrum short, depressed, bifid, each horn terminated by three spines. Orbits with two large fissures above, below with two broad, acute teeth. Antero-lateral margin with four sub-equal, slender, acute, curved teeth; a small one on the postero-lateral mar-

gin behind the lateral tooth. Sub-hepatic regions with spiniform tubercles. Basal joints of antennae with hairs and short setae. Chelipeds short and very slender, hand naked, the other joints and ambulatory feet above with spines and spiniform tubercles interspersed with short hairs. Dactyli of four posterior pairs curved, acute.

Florida. A. S. Packard, Jr.

A male gives the following measurements.

Length of carapax, 10 mm.; breadth, 10.5 mm.; ratio, 1:1.05.

This species differs from *M. affinis*, *acuticornis*, and *Holderi* in having the rostral horns spined instead of obtuse and unarmed; from *M. coronatus* in the broader carapax and non-acuminate horns; from *M. spinosissimus* in the simple character of the antero-lateral teeth; from *M. aculeatus* and *verrucosus* in having the basal joint of antennae two spined; from *M. hispidus* in the absence of sulci, and presence of granulations on the carapax, the more spiniform marginal teeth and longer rostral horns; from *M. pleuracanthus* in the granulate carapax and the character of rostrum, and from *M. verrucosus* in the rostral horns and the acute marginal teeth.

Mithrax triangulatus.

Mithraculus triangulatus Lockington, Proc. Cal. Acad., VII, 73, (1876).

Carapax with the regions very protuberant and tuberculate, especially the outer part of the branchial, the gastric and cardiac. Rostrum short, bifid, horns extending beyond the orbits, with the margins crenulate. Inner angle of orbits prominent, acute; superior margin with two nearly obsolete fissures, external hiatus moderate; below, a fissure at the junction of the basal joint of antennae. Antero-lateral margin three lobed, and below the lobes perpendicular. Below with two tubercles beneath the orbit, one small one on the subhepatic region and three rows of tubercles on the perpendicular surface of the branchial region, the lower of which extends obliquely forward to the angle of the palatal region. Basal joint of antennae very broad with two teeth, (not spines). Chelipeds moderate, meros sub-cylindrical with a few small tubercles; carpus nearly smooth, rounded; hand inflated, smooth, fingers moderately gaping, extremities denticulate, a strong basal tooth on the dactylus. Remaining feet small, spinotuberculate.

Gulf of California. W. N. Lockington.

Length of carapax, ♂, 12.4 mm., ♀, 11.1 mm.; breadth, ♂, 11.5 mm., ♀, 11.0 mm.; ratio, ♂, 1: .93, ♀, 1: .99.

Family PARTHENOPIDÆ. Sub-Family PARTHENOPINÆ.

Genus LAMBRUS Leach.

Lambrus granulatus sp. n.

Carapax broader than long, everywhere granulate and with scattered tubercles; of these there are four in the median line, three on the cardiac region and the fourth on the posterior margin; four distant ones on the branchial regions and an indistinct one on the hepatic region. Rostrum moderate, directed downward, the sides (inner borders of the orbits) elevated, extremity acute with a single tooth on each side at the base. Orbits with a distinct fissure above. Antero-lateral margin strongly angulated at about the middle, with about thirteen serrated teeth, of which seven are posterior to the angle; posterior tooth larger and stouter than the rest and directed slightly backwards. Posterior margin with three tubercles. Sub-hepatic and pterygostomian regions excavate as in *L. crenulatus* and *laciniatus*. Sternum granulate. Chelipeds long, surface everywhere granulate; meros nearly triangular in section, bordered with large serrated teeth on the two upper margins and with smaller ones beneath; a tuberculate crest on the upper surface; carpus with two large teeth on the outside and a number of smaller ones on the inner; upper surface of hand without tubercles, superior and inferior margins with fine teeth, outer margin with alternate large and small teeth; fingers strongly inflexed. Remaining feet slender, of moderate length. First segment of male abdomen with a transverse series of five tubercles.

Tortugas, Fla., (9 faths.). Lieut. Jacques.

Length of carapax, ♂, 8 mm.; breadth, 9 mm.; ratio, 1:1.25.

This form differs from *L. Pourtalesii* in the ornamentation of the carapax, the absence of a hepatic tooth, in the large number of marginal teeth; from *L. agonus* in the angulated sides.

It is nearest *L. crenulatus* and would fall in the section which Dr. Stimpson has designated under the name *Platylambrus*.¹ It is, however, separated from this species by the more slender rostrum, the less prominent tooth at the lateral angle, the and smaller number of tubercles on the carapax; the regions also are not so well defined.

¹ Bulletin Museum Comparative Zoology, II, 129, (1871).

CANCROIDEA.

Family CANCRIDÆ. Sub-Family XANTHINÆ.

Genus PANOPEUS Edwards.

Panopeus affinis Streets and Kingsley.

Panopeus transversus Lockington, Proc. Cal. Acad., VII, 102 (1876) non Stm. *Panopeus affinis* Streets and Kingsley, Bulletin Essex Inst., IX, 106 (1877).

Carapax depressed, slightly convex, and with the exception of frontal and antero-lateral portions which are granulate and sparsely pubescent, the surface is smooth and naked. Front rather prominent, bilobed, the lobes being truncate, not sinuate, the sides more advanced than the middle. The two fissures of the upper margin of the orbits more distinct than in *P. transversus*; the inner portion of the upper margin is elevated, forming a distinct angle with the upper surface of the frontal region. Antero-lateral margin with teeth rather than lobes, the first (the second normal tooth united to the angle of the orbit) is slightly sinuate as in *P. crenatus*, but is not so broad as in that species. Remaining teeth acute with their exterior margins arcuate, the margins of all the teeth slightly elevated. Under surface granulate, pubescent, subhepatic tubercle indistinct. Chelipeds unequal, carpus of each smooth, with a short spine on the inner margin; large hand smooth, the tooth on the outside of the palm obsolete; dactylus of larger hand with a strong basal tooth. Palm of smaller hand roughened above; fingers of both hands with longitudinal impressed lines, better defined, however, on the smaller. Remaining feet compressed, pubescent; dactyli of second, third and fourth pairs long and slender, of fifth pair much shorter. Terminal segment of male abdomen no broader than the preceding joint, sides slightly arcuate, tip rounded.

Lower California. W. N. Lockington.

Length of carapax, ♂, 10.8 mm., ♀, 12.7 mm.; breadth, ♂, 15.2 mm., ♀, 16.7 mm.; ratio, ♂, 1: 1.41, ♀, 1: 1.31.

It is closely related to *P. transversus* Stm., and *P. crenatus* Edw. and Lucas, but is distinguished from both by the truncate, non sinuate front and the less lobular teeth of the antero-lateral margin with their elevated borders. From *P. crenatus* it is also separated by the presence of a sub-hepatic tubercle and a more depressed carapax; from *P. transversus* by the more concave upper margin of the orbit, its elevated inner portion and the more acute carpal spine.

Panopeus purpureus Lockington.

Panopeus purpureus Lockington, l. c. VII, 101, 1876; Streets and Kingsley, l. c. IX, 105 (1877).

This form is very near *P. validus* Smith, and probably will prove to be merely a variety of it. In comparison with Smith's description and with authentic specimens of *P. validus* brought from the Gulf of Fonseca, by J. A. McNiel, it presents the following differences: Carapax smoother, and the granulous rugæ less numerous; front less prominent and, seen from above, nearly straight; fissures of the orbit less evident; tooth at inner angle of orbit below broader and shorter, second normal tooth of antero-lateral margin separated from the angle of the orbit by a narrower, more triangular notch; notches between the remaining teeth narrower, the teeth themselves having a distinct elevated margin. Propodus of chelipeds with an obtuse crest above; the tooth on the outer surface of larger hand nearly obsolete, dactylus with a large basal tooth. Ambulatory feet less compressed than in *P. validus*.

Lower California. W. N. Lockington.

Length of carapax, ♂, 11.1 mm.; breadth, 15.4 mm.; ratio, 1: 1.39.

Gulf of Fonseca, west coast of Nicaragua, J. A. McNiel.

Length of carapax, ♂, 13.2 mm.; breadth, 18.3 mm.; ratio, 1: 1.39.

Panopeus Packardii sp. n.

Carapax moderately convex; areolations less prominent than in *P. Herbstii*, surface minutely granulous. Front prominent, nearly horizontal; edge thin, arcuate, bilobed, the lobes being separated by a shallow groove. Orbits with two fissures above; post orbital tooth separated from the second tooth nearly as in *P. americanus* Saussure; the remaining teeth more acute than in *P. Herbstii*. External hiatus of orbit a narrow fissure. Sub-hepatic tubercle present, small; sub-hepatic regions minutely granulate. Chelipeds unequal; meros with one or two spines on the superior margin near the middle; carpus with a spine on the inner margin; larger hand stout, a rounded tooth below the articulation of the dactylus, dactylus with a strong basal tooth; fingers slightly deflexed; smaller hand with the tooth near the articulation of the dactylus broader and less prominent, and the fingers more strongly deflexed than in the larger hand, dactylus without a basal tooth.

Key West, Florida. A. S. Packard, Jr.

Length of carapax, ♂, 10.5 mm.; breadth, 14 mm.; ratio, 1: 1.33.

This species differs from *P. serratus*, *Hartii*, *americanus*, *politus* and *transversus* in the acute antero-lateral teeth; from *P. Herbstii*, *planissimus*, *abbreviatus* and *depressus* in the produced, arcuate, bilobed front; from *P. texanus* in the presence of a tooth on the external surface of the hand, and in having the terminal joint of the male abdomen triangular and no broader than preceding joint; from *P. occidentalis*, *Sayi* and *texanus* in the basal tooth of the dactylus; and from *P. Wurdemanni* and *Harrisii* in having the edge of the front simple, while in those species it is bi-marginate.

Panopeus sp.

? *Xanthodes leucomanus* Lockington, l. c. VII, 100 (1876).

The specimen sent by Mr. Lockington as the type of his *X. leucomanus* is a species of *Panopeus* very near *P. crenatus* Edw. and Lucas, but is too young for specific determination.

Genus XANTHO Leach.

Xantho novem-dentatus Lockington.

Xantho novem-dentatus Lockington, l. c. VII, 32 and 99 (1876).

Carapax moderately convex in front, the anterior portion roughened, behind smooth; the areolations in front are well marked and protuberant. Front produced as in the allied species (*X. 16-dentatus* and *vittata*) two lobed, lobes arcuate with crenulated margins and separated from each other by a slight fissure, and from the prominent inner angle of the orbit by a deep rounded notch. Orbits two-fissured above. Antero-lateral margin with seven small, sharp, distant teeth; one or two small teeth on the postero-lateral margin behind the lateral angle. Chelipeds unequal, carpus and hand roughened above, the spine on the inner surface of the carpus small, acute; hands with a sulcated crest above. Posterior feet compressed, ciliated, not armed with spines.

Lower California. W. N. Lockington.

Length of carapax, 11.7 mm.; breadth, 15.2 mm.; ratio, 1: 1.30.

Is very closely allied to *X. 16-dentatus* Edw. and Lucas, *X. vittata* Stimpson, and falls in Lucas' genus *Paraxanthus*. It is separated from *X. 16-dentatus* by the more distinct areolation of the carapax, and the arcuate front; from Stimpson's description of *X. vittata* by not having the gastric region divided into three lobules, and by the crenulated non-ciliated front.

Genus CHLORODIUS Leach.

Chlorodius Fisheri Lockington.

Chlorodius Fisheri Lockington, *l. c.* VII, 104 (1876). Streets and Kingsley, *l. c.*, IX, 106 (1877).

This species belongs to the second section of the genus characterized by Prof. Dana, in the U. S. Exploring Expedition Crustacea, as having the carapax areolate in front, behind smooth or imperfectly areolate. Areolet "2 m" not subdivided. Anterior feet unarmed above. Third joint of the eight posterior feet not spinulose.

Carapax moderately areolate in front, obscurely so posteriorly, areolets not so prominent as in *C. floridanus* and *exaratus*; surface slightly rugulose anteriorly, but less so than in *C. floridanus*. Front two lobed, lobes separated by a narrow, acute fissure and with their anterior margins truncate, margins sulcate but not so deeply as in *C. floridanus*. Orbits two fissured above, entire below, the inner inferior angle acute. Antero-lateral margin four-toothed, teeth nearly as in *C. floridanus*. A small tubercle exists between and below the angle of the orbit and the first antero-lateral tooth. Carpus and hand of chelipeds slightly roughened exteriorly, but not so much so as in *C. floridanus*. Posterior feet compressed, unarmed.

Gulf of California. W. N. Lockington.

Length of carapax, ♂, 10 mm., ♀, 15.4 mm.; breadth, ♂, 14 mm., ♀, 22 mm.; ratio, ♂, 1 : 1.40, ♀, 1 : 1.43.

This species differs from Stimpson's short description of *C. occidentalis* (Annals N. Y. Lyc., x, 108) in the narrower carapax, the length being to the breadth in the ratio 1 : 1.64, and in the form of the front. Stimpson says "the median lobes, or teeth of the front, do not project beyond the lateral ones." From *C. floridanus* it differs in the less protuberant areolets, the truncate frontal lobes, the smoother chelipeds, and the less concave sides of the terminal segment of the male abdomen.

Family ERIPHIDAE. Sub-Family OZINÆ.

Genus PILUMNUS Leach.

Pilumnus spinohirsutus Streets and Kingsley.

Acanthus spinohirsutus Lockington, *l. c.*, VII, 32 and 102 (1876). *Pilumnus spinohirsutus* Streets and Kingsley, *l. c.*, IX, 107 (1877).

Carapax arcuate, covered with scattered tubercles, which behind

are squamiform and nearly obsolete, but in front are prominent and almost spiniform. Areolations but faintly marked. Front depressed with two prominent lobes separated by a fissure, and each lobe armed with a varying number (three to five) acute spines. The lobes are emarginate near the orbit, at the angle of which is a single stout spine. Orbits with distant spines above and below. Antero-lateral margin with three strong spines, and beneath and in front of the first of these is another. Pterygostomian region tuberculate. Meros of chelipeds with a spine, at the upper distal angle an emargination interior to this spine, behind which is a second spine; carpus and propodus with strong spines and hairs on the upper and outer surfaces, which below are arranged in rows and become tuberculiform; fingers dark brown, almost black. Ambulatory feet with long hairs on all the joints, and slender spines on the carpal, meral, and distal portion of the ischial joints.

Gulf of California. W. N. Lockington.

Length of carapax, ♂, 11 mm., ♀, 17.8 mm.; breadth, ♂, 16.7 mm., ♀, 24.8 mm.; ratio, ♂, 1: 1.52, ♀, 1: 1.41.

***Pilumnus dasypodus* sp. n.**

Carapax transversely nearly flat, but longitudinally strongly arcuate, smooth behind but with the areolations moderately distinct anteriorly, clothed with long clavate hairs and stiff setae. Front depressed, prominent, two lobed, the lobes being separated by a deep narrow fissure, and each armed with minute teeth. Orbits with distant spines above and below, hiatus wanting. Antero-lateral margin with three strong simple spiniform teeth besides the one at the angle of the orbit. No spines on the hepatic or pterygostomian regions. Chelipeds unequal, carpus and propodus armed above with strong spines, stiff setae and long clavate hairs which on the smaller hand extend on the external surface where the spines become tuberculiform, and are arranged in distinct rows; fingers short, stout, denticulated. Ambulatory feet stout, compressed.

Key West, Florida. A. S. Packard, Jr.

Length of carapax, ♂, 5 mm., ♀, (with eggs) 6.2 mm.; breadth, ♂, 7.2 mm., ♀, 8.8 mm.; ratio, ♂, 1: 1.44, ♀, 1: 1.42.

This form is distinguished from *P. aculeatus* by the absence of spines on the hepatic region, from *P. Xantusii*, *gemmatus*, *reticulatus*, *ceratopus*, *marginatus*, *Agassizii*, *caribaeus*, *floridanus*, *granulimanus*, *lacteus* and *nudifrons* by having the orbits with spines above and below; from *P. depressus* in the simple character of the antero-lateral

teeth, from *P. lunatus* by the ridge on the endostome. It is nearly related to *P. spinohirsutus* of the Pacific coast, but differs in the denticulated instead of spiny front, and the absence of granulations on the pterygostomial region, etc.

***Pilumnus melanacanthus* sp. n.**

Carapax depressed, regions but faintly indicated, minutely granulated, with several small spines on the hepatic regions. Front broad, horizontal, almost bimarginate; on the upper margin a transverse row of spines directed forward, below which is a second margin of four dentated lobes, the median two being narrow, long, and truncate, the lateral ones broad and arcuate in outline, the teeth becoming larger near the orbits. Orbits above and below with minute acute spines. Antero-lateral margin with three strong, acute spines (besides the angle of the orbit) hooked forward, between which are a number of smaller ones. No spines on the pterygostomial region. Anterior margin of palatal region spined. Chelipeds stout, and armed above with stout black spines. Ambulatory feet without spines, stout, compressed and hairy above.

Key West, Florida. A. S. Packard, Jr.

Length of carapax, 7 mm.; breadth, 9 mm.; ratio, 1: 1.28.

Is most nearly allied to *P. depressus* of the west coast, from which it differs in the spines of the antero-lateral margin, the absence of a subhepatic tooth and the spiniform ornamentation of the chelipeds. From *P. aculeatus* it is distinguished by the greater number of hepatic spines, and the absence of the pterygostomial spine; from *P. spinohirsutus* by the depressed and narrower carapax, and having the hands armed above only; from *P. gemmatus*, *Xantusii*, *reticulatus*, *lunatus*, *ceratopus*, *marginatus* and *floridanus* in having the orbits toothed above and below and with no hiatus, except the one at the inner angle; from *P. Agassizii* in the depressed carapax, absence of areolation, etc.

Family PORTUNIDAE. Sub-Family LUPINÆ.

Genus CALLINECTES Stimpson.

***Callinectes dubia* sp. n.**

Surface finely granulate, median lobes of front small and not projecting as far as the lateral ones. Orbits with two obsolete fissures above. Antero-lateral margin with nine teeth, including the lateral tooth of the carapax; anterior tooth truncate, posterior acute, lateral

tooth nearly three times as long as preceding one. Eyes moderate. Antennae about one-third the length of the carapax, the two distal joints of the peduncle subequal. External maxillipeds fringed with hairs, the surface granulate. Ischium of chelipeds minutely granulate, with three spines on the inner margin, the third farther from the second than the second from the first, external margin distally emarginate, external distal angle with a short acute spine; carpus externally with several irregular raised lines, a small spine externally. Hand slender, nearly as long as the carapax, and ornamented with raised lines; of these there are two on the upper surface, three on the inner, the lower being less distinct than the other two, and on the outer surface are two more, the lower being more distinct on the thumb but fading out about the middle of the palm. Fingers about as long as the palm, slender, and somewhat curved downward. Second and third pairs of feet compressed, subequal, fourth pair also compressed, the extremity of the dactylus reaching to the propododactylic articulation of the preceding pair. Fifth pair equalling the fourth in length, the dactylus being a half longer than broad. Sternum nearly as long as broad, transversely but slightly convex. Abdomen of male slender, the sutures mostly indistinct, last segment tapering, as long as broad, extremity rounded. Verges slender, their distal portion straight and reaching to the middle of the third segment of the sternum, or nearly to the extremity of the penultimate segment of the abdomen.

This species resembles *C. pleuriticus* Ordway, more closely than it does any other west coast form. It differs however in the following particulars. The external teeth of the front are more prominent, the antero-lateral teeth are more crowded together, the fissures between them being nearly closed, the male verges are larger and with the extremities straight, and the antero-lateral margin is but very slightly arcuate.

Several specimens from the Gulf of Fonseca, west coast of Nicaragua. A male gives the following measurements.

Length of carapax, 21.3 mm.; breadth, 45 mm.; ratio, 1 : 2.11.

I have found it very difficult to distinguish the species of this genus as the published descriptions are almost wholly comparative, and unless one has a large proportion of the species, determination is by no means an easy matter.

OCYPODOIDEA.

Family GRAPSIDÆ. Sub-Family GRAPSINÆ.

Genus PACHYGRAPSUS Randall, Stimpson.

Pachygrapsus transversus Gibbes.

Grapsus transversus Gibbes, Proc. Am. Assoc. Adv. Sci., III, 181 (1851). *Pachygrapsus transversus* Gibbes, l. c., 182, Stimpson, Annals N. Y. Lyc., VII, 64 (1859); *ibid*, l. c., X, 113 (1871); Smith, Report Peabody Acad. Science, III, 91 (1871). *Metopograpsus dubius* Saussure, Crustacés Antilles, Mexique et Etats Unis, p. 29, pl. II, f. 16 (1858). *Metopograpsus miniatus* Saussure, l. c., p. 28, pl. II, f. 17, (1858).

Carapax smooth, shining, with crenulated transverse ridges, oblique on the branchial regions. Supra-frontal lobes prominent, but not so much as in specimens of *P. plicatus* from Tahiti. Front sinuate, making with the inner margin of the orbit a right angle, and viewed from in front, undulating. Orbits with the inferior margin making a sharp angle with the external tooth. A single acute tooth on the lateral margin, margin generally arcuate. The meros of the external maxillipeds is as broad as long, chelipeds unequal; meros crossed by crenulated ridges similar to those on the carapax, inner distal margin armed with from three to five acute teeth; carpus with the ridges less distinct, a prominent rounded tooth on the inner surface; hand minutely granulate, margins rounded; a ridge runs on the lower outer surface from near the base of the palm to the extremity of the pollex; fingers slightly gaping, smooth above and below, the occludent margins finely toothed. Posterior feet with the distal inferior angle with two to four teeth; meros of the first three pairs with a sharp ridge on the anterior and posterior margins; meral and propodal joints of all the ambulatory feet with long hairs; dactyli spinose, stout and with scattered long hairs.

In examining fifty-five specimens of *Pachygrapsi* brought from Key West, Florida, by Dr. Packard, I found forty-nine specimens which I referred without a doubt to *P. transversus*, four to *P. gracilis* and two doubtful ones which resemble Saussure's description and figure of *Metopograpsus miniatus*. These have the narrower front and slightly more arcuate lateral margins, but I can hardly consider them as distinct from *P. transversus*. In the above forty-nine specimens of *P. transversus* I found a variation in the arcuation of the lateral margin, and

in the relative widths of front and carapax; there is also a variation in the ornamentation of the carapax; in some the cardiac region is smooth, in others crossed by elevated ridges. It would thus seem proper to unite these two forms, especially since Saussure says in the closing paragraph of his description of *Metopograpsus dubius*, "Je ne connais pas suffisamment bien les rapports de différence qui séparent les crustacés assez rares de ce genre pour oser rien formuler de précis quant à cette espèce, qui je serais enclin à considérer comme le femelle du *M. miniatus*, sans l'extrême largeur de son front et la forme bien différente de sa carapace."

Pachygrapsus gracilis Stimpson.

Metopograpsus gracilis Saussure, l. c., p. 27, pl. II, f. 15 (1858).

Pachygrapsus gracilis Stimpson, Annals N. Y. Lyc., x, 113 (1871).

This species is readily separated from the preceding by the following characters. Cardiac region without transverse elevated lines, supra-frontal lobes nearly obsolete; front regularly arcuate, making an angle of about one hundred and twenty degrees with the inner margin of the orbit, and viewed from in front nearly horizontal; inferior margin of orbit not making an angle with the external orbital tooth; lateral margin nearly straight; meros of external maxilliped a half broader than long. The upper margin of the dactyli of the chelipeds and lower margins of the hand are denticulated; the carapax is narrower and more convex than in *P. transversus*. There appears also the following difference in alcoholic specimens. In *P. transversus* there are irregular patches of darker color on the carapax and hands, while in *P. gracilis* there are minute specks of black on the same portions.

LEUCOSOIDEA.

Family CALAPPIDÆ. Sub-Family CALAPPINÆ.

Genus CALAPPA Fabr.

Calappa convexa Saussure.

Calappa convexa Saussure, Revue et Magazin de Zoologie, v, pl. XIII, f. 3, (1853); Stimpson, Boston Journal Nat. Hist., vi, 470, (1857); *ibid*, Annals N. Y. Lyceum Nat. Hist., x, 114, 1871. *Calappa xantusiana* Stm., Ann. N. Y. Lyc., vii, 237, (1860).

A large male of this species from Panama (J. H. Sternberg) gives the following measurements.

Length of carapax, 55 mm.; breadth, 83 mm.; ratio, 1: 1.51.

Saussure's measurements are : length of carapax, 1 in. 7 lines; breadth, 2 in.; ratio, 1: 1.26.

Stimpson's measurements are: length of carapax, 1.15 in.; breadth, 1.46 in.; ratio, 1: 1.27.

Other than this variation in proportions, which may be due to age, the specimen agrees well with the descriptions and figures quoted above. The following additional characters may however be noted: External maxillipeds hirsute, the ischium toothed on the inner margin; chelipeds externally tuberculate, the tubercles growing smaller and exhibiting a tendency to arrange themselves in rows below; a strong spine arises from the inferior margin of the propodus near the base and extends horizontally outward and forward. The dactylus of the (in our specimen) right hand is compressed, with a crest of rounded teeth above, the first being larger than, and somewhat distant from, the rest; a strong curved tooth projects downward from the outer surface of the dactylus near the articulation with the propodus. The second and third joints of the abdomen are broader than the following ones, the second being tuberculate; the last joint is a third longer than broad.

With the regards of
J. S. Kingsley

ON A COLLECTION OF CRUSTACEA FROM VIRGINIA, NORTH CAROLINA,
AND FLORIDA, WITH A REVISION OF THE GENERA OF CRANGONIDÆ
AND PALEMONIDÆ.

BY J. S. KINGSLEY.

The specimens enumerated below were collected, with a few exceptions, by Prof. H. E. Webster, of Union College, at Northampton County, Virginia (eastern shore, Atlantic side), beach of Chesapeake Bay, opposite Fort Monroe, Va., in the vicinity of Beaufort, N. C., and Marcou Pass, Florida Bay, Harbor Key, Plantation Key, and Key West, Southern Florida, and Oyster Bay, Charlotte Harbor, Sarasota Bay and Little Sarasota Bay, on the west coast of Florida. I have endeavored to indicate to a certain extent the geographical distribution of the species by giving, in most instances, a list of localities from which specimens have been reported, with the authority for the statement. In cases where I have personally examined specimens, I have placed an exclamation mark (!) after the locality followed by the name of the collector. The arrangement followed in the Maiioidea is that of Miers (Jour. Linn. Soc'y, xiv. pp. 634-673, 1879). In the remaining groups of the Brachyura, mainly that of Dana, the Anomura, according to Stimpson (Proc. Acad. Nat. Sci. Philadelphia, 1858, pp. 225-238), while the order of the Macrura is essentially that of Dana. A short notice of some of the new forms will be found in the American Naturalist, vol. xiii. p. 584, September, 1879.

ORDER DECAPODA.

Sub-Order MAIOIDEA *vel* OXYRRHYNCHA.

FAMILY INACHIDÆ Miers.

Sub-Family Leptopodiinæ Miers.

Genus LEPTOPODIA Leach.

Leptopodia sagittaria Leach.

Cancer sagittarius Fabr., Ent. Syst., ii. p. 442.

Inachus sagittarius Fabr., Suppl. Ent. Syst., p. 359.

Macropus sagittarius Latreille, Hist. Crust. et Insects, ii. p. 112.

Leptopodia sagittaria Leach, Zool. Misc., ii. pl. lxxvii.

Leptopodia ornata Guilding, Trans. Linn. Soc'y London, xiv. p. 335 (1823).

Leptopodia lanceolata Brullé in Webb and Berthelot's Hist. Canaries, pl. i. (1836-1844).

Five specimens were collected at Sarasota Bay, Fla. This species has quite an extended range in the tropics. Stimpson reports it from the Florida Reefs and Madeira Is.; von Martens from Cuba; Guadeloupe (Latr., Martens, and Desbonne), Gulf of Mexico and Antilles (Edw. and Gibbes), Canary Is. (Brullé), Cayenne and Bahia, Brazil (A. M. Edw.). Alphonse Milne Edwards maintains the identity of *Leptopodia debilis* Smith¹ with this species. If it prove identical, the following localities on the west coast of America will have to be added to the list: Valparaiso (Bell, Edw., and Lucas), Panama (Smith), Realijo, west coast of Nicaragua! (McNiel).

I find among the Guérin collection in the Museum of the Academy of Natural Sciences of Philadelphia, a specimen labelled "*Leptopodia vittata* Guér., Senegal." I have not been able to find any description of this species under that name, and possibly it was a MS. one. However I am unable to separate it from Floridan forms.

Genus **METOPORHAPIS** Stm.

Metoporhapis calcarata Stm.

Leptopodia calcarata Say, Journ. Acad. Phila., i. p. 445. Edw., Hist. Crust., i. p. 276.

Metoporhapis calcarata Stm., Ann. Lyc., vii. p. 198.

Nine specimens of this rare species were collected at Sarasota Bay and one, young, at Charlotte Harbor. The other localities are Beaufort, N. C. (Stm.); Charleston, S. C. (Say, Edwards, Gibbes).

Sub-Family **Achæinæ**.

Genus **CORYRHYNCHUS** Kingsley. (*Podonema* Stm., præoc.)

Coryrhynchus riisei Kingsley.

Podochela riisei Stm., Ann. Lyc., vii. p. 196, pl. ii. f. 1.

Podonema riisei Stm., B. M. C. Z., ii. p. 126.

Coryrhynchus riisei Kingsley, Am. Naturalist, xiii. p. 585.

¹ *Leptopodia sagittaria* Bell; Edw. et Lucas in D'Orbigny, Voyage dans l'Amérique Meridionale, p. 3, pl. iv. f. 3.

Leptopodia debilis Smith, Second and Third Report, Peabody Acad. Sci., p. 87.

Specimens were collected at Sarasota Bay. Stimpson had it from St. Thomas and Tortugas. I have seen specimens from Key West (A. S. Packard, Jr.).

Sub-Family **Inachinæ** Miers.

Genus **CHORINUS** Leach.

Chorinus heros Leach.

Cancer heros Herbst, Krabben und Krebse, pl. 42, f. 1.

Chorinus heros Leach MS., M. Edw., Crust., i. p. 315. Von Martens, Arch. für Naturgesch., xxxviii. p. 80, pl. iv. f. 2.

Specimens in the Museum of the Peabody Academy (Florida, C. J. Maynard) afford the following measurements:—

Length of Carapax.	Breadth.	Ratio.
44 mm.	22.5 mm.	100 : 51
42 mm.	22. mm.	100 : 52

It has been reported from Key West (Gibbes), Cuba (Martens, A. M. Edw.), Antilles (M. Edw.), Martinique and Barbadoes (A. M. Edw.), Guadeloupe (Desbonne).

Sub-Family **Acanthonychinæ** Miers.

Genus **EPIALTUS** Edw

Epialtus longirostris Stm.

Epialtus longirostris Stm., Ann. Lyc., vii. p. 199. A. M. Edw., Crust. Mex. et Ant. Cent., p. 141, pl. xxvii, f. 5.

Two specimens of this species were collected at Sarasota Bay.

Epialtus minimus Lockington (Proc. California Acad., 1877, p. 77) is a closely allied species, and possibly both should be separated from the species with a shorter rostrum.

Key West (Stm.), St. Thomas (Stm., A. M. Edw.).

FAMILY **MAIIDÆ**.

Sub-Family **Maininæ**.

Genus **PELIA** Bell.

Pelia mutica Stm.

Pisa mutica Gibbes, Proc. Am. Assoc., iii. p. 171.

Pelia mutica Stm., Ann. Lyc., vii. p. 177. A. M. Edw., Crust. Mex. et Am. Cent., p. 73, pl. xvi. f. 2.

Specimens were collected at Northampton Co., Va., Beaufort, N. C., and Florida Bay, Fla. Prof. Gibbes' types were from

Charleston, S. C. Stimpson found it at Martha's Vineyard, Mass. Dr. Packard collected specimens at Key West, Fla.!

FAMILY **PERICERIDÆ** Miers.

Sub-Family **Pericerinæ** Miers.

Genus **LIBINIA** Leach.

Libinia dubia M. Edw.

Libinia dubia M. Edw., Hist. Crust., i. p. 300, pl. xiv bis, f. 2. Streets, Proc. Phila. Acad., 1870, p. 104. A. M. Edw., Crust. Mex. et Am. Cent., p. 129, pl. xviii, f. 5.

Libinia distincta, Guerin in de Sagra's Cuba, p. 12.

Northampton Co., Va., Morehead Depot and Beaufort, N. C., Little Sarasota Bay, Fla. Two males from the latter locality have the following dimensions:—

Length of Carapax.	Breadth.	Ratio.	Length of 2d feet.
73 mm.	65 mm.	100 : 89	143 mm.
64 mm.	50 mm.	100 : 78	104 mm.

Other localities are Cape Cod to Florida (Smith); Nantucket, Mass. (Packard), Long Island (Streets), Charleston, S. C. (Gibbes), Key West (Packard).

Libinia emarginata Leach.

Libinia emarginata Leach, Zoological Miscellany, iii. p. 130, pl. 108 (1815).

Libinia canaliculata Say, Jour. Phila. Acad., i. p. 77, pl. iv. f. 1. M. Edw., Hist. Crust., i. p. 300. Dekay, N. Y. Fauna, Crustacea, p. 2, pl. iv. f. 4.

Libinia affinis Randall, Jour. Phila. Acad., viii. p. 107 (1839).

Randall's types show no characters of specific importance separating them from *L. emarginata*, and hence his name will have to pass into synonymy.

Prof. Webster's localities are North Hampton Co., Va.! Sarasota Bay! and Marcou Pass, Fla.! Other stations are Casco and Cape Cod Bays (Smith), Massachusetts Bay! Nantucket, Mass. (Packard), Key West, west coast of Fla., and Nassau, N. P. (Smith), W. C. North America! (Nuttall).

Genus **MICROPHRYS** M. Edw. (= *Milnia* Stm.)

Microphrys bicornuta.

Pisa bicornuta Latr., Encyc. Method, t. x. p. 141.

Pericera bicorna M. Edw., Hist. Crust., i. p. 337.

Pisa bicorna Gibbes, Proc. Am. Assoc., iii. p. 170.

Pericera bicornata Guerin in Raman de Sagra, p. 12. Von Martens, Arch. für Naturgesch., xxxviii. p. 85, pl. iv. f. 4.

Pericera bicornis Sauss., Crust. Mex. et Antilles, p. 12, pt. i. f. 3.

Milnia bicornuta Stm., Ann. Lyc., vii. p. 180.

Microphrys bicornuta A. M. Edw., Mission Sci. Mex. et Am. Cent. Crust., p. 61, pl. xiv. f. 2-4.

Pisa galbica et *Pisa purpurea* Desbonne and Schramm, Crust. Guad., p. 18.

Omalaacantha hirsuta Streets, Proc. Phila. Acad., 1871, p. 238.

Specimens were collected at Plantation Keys, Florida Bay, Key West. Specimens from Plantation Keys gave the following measurements:—

Sex.	Length of Carapax.	Breadth.	Ratio.
♂	27.4 mm.	18.7 mm.	100 : 68
♂	31. mm.	21.2 mm.	100 : 68
♀	22. mm.	14.8 mm.	100 : 68

An examination of the single specimen which formed Streets' type of *Omalaacantha hirsuta*, which is preserved (in a dry state) in the Museum of the Philadelphia Academy, convinces me that Alphonse Milne Edwards was correct in supposing it a variety of *M. bicornutus*. It stands midway between the typical form (fig. 3, of A. Edw.) and that described by Desbonne as *Pisa galbica* (fig. 4, of A. Edw.). It, however, differs from both in a much smaller chiliped.

Tortugas (Stm.), Key West! (Packard), Antilles (Edwards, Saussure), Bermudas (Smith), Guadeloupe (Desbonne), Mexico (A. M. Edw.), Aspinwall! (McNiel), Desterro, Brazil (A. Edw.), Abrolhos, Brazil (Smith).

Genus **MACROCOLÆMA** Miers.

Macroceloma trispinosa Miers.

Pisa trispinosa Latreille, Encyc. Method, x. p. 142.

Pericera trispinosa M. Edw., Hist. Crust., i. p. 336. Von Martens, l. c., xxxviii. p. 84, pl. iv. f. 4. Schramm, Rev. et Mag. de Zool. III., ii. p. 342.

Pericera nodipes Desbonne and Schramm, op. cit., p. 15, pl. v. f. 13.

Macroceloma trispinosa Miers, Jour. Linn. Soc'y, xiv. p. 665.

A single male was collected at Key West. Key West (Gibbes, Stm.), Tortugas (Stm.), Cuba (Martins), Guadeloupe (Desbonne).

Sub-Family **Othoniinae**.Genus **OTHONIA**,¹ Bell.**Othonia aculeata** Stm.*Hyas aculeatus* Gibbes, Proc. Am. Assoc., iii. p. 171.*Othonia aculeata* Stm., Ann. Lyc., vii. p. 49. A. M. Edw., Crust.

Mex. et Am. Cent., p. 115, pl. xxiv. f. 4.

Othonia therminieri Desbonne and Schramm, op. cit., p. 20. A. M. Edw., op. cit., p. 116, pl. xxiv. f. 5.*Othonia anisodon* von Martens, l. c., xxxviii. p. 83, pl. iv. f. 2.

Professor Webster collected specimens of this species at Sarasota Bay and Harbor Key, Fla. I have examined others in the Museum of the Peabody Academy from Florida (C. J. Maynard) and Key West (A. S. Packard). I can see no constant differences to separate the forms described as *therminieri* and *anisodon* from typical forms. The teeth of the antero-lateral margin are variable, and differ frequently on the two sides of the same specimen. A young specimen from Sarasota Bay had but four teeth on the anterolateral margin besides the angle of the orbit, but I could find no other differences. In ten specimens the ratio of the length to the breadth ranged from 100 : 81 to 100 : 94, with an average of 100 : 86. Other localities are Key West (Gibbes, Stm.), Tortugas (Stm., A. M. Edw.), Cuba (Martens), Guadeloupe (Desbonne), St. Thomas (A. M. Edw.).

Sub-Family **Mithracinae**.Genus **MITHRACULUS** White.**Mithraculus coronatus** White.*Cancer coronatus* Herbst, pl. xi. f. 63.*Mithraculus coronatus* White (pars), List Brit. Mus. Crust., p. 7. A.

M. Edw., Crust. Mex. et Am. Cent., p. 105, pl. xx. f. 1.

Five specimens were collected at Key West, from which place I have examined others collected by Dr. A. S. Packard, Jr.

Sex.	Length of Carapax.	Breadth.	Ratio.
♂	14.5 mm.	17.9 mm.	100 : 123
♂	10.8 mm.	14.9 mm.	100 : 138
♀	12. mm.	14.5 mm.	100 : 121

¹ The generic name *Othonia* was used by Johnston (Loudon's Magazine of Natural History, viii. p. 181, 1835) for a genus of worms, but since he has been followed by no other author, with the exception of Gosse, and as his single species has been assigned to the genus *Amphicora*, I refrain from proposing a new name for Bell's genus.

Other localities are Tortugas and Aspinwall, Abrolhos, Brazil (Smith), St. Thomas and Guadeloupe (A. M. Edw.).

Mithraculus sculptus Stm.

Maia sculpta Lamarck, An. sans Vertebres, v. p. 242.

Mithrax sculptus Edw., Mag. de Zool., 1832, pl. v.; Hist. Crust. i. p. 322.

Mithraculus sculptus Stm., Am. Jour. II., xxix. p. 132. A. M. Edw., Crust. Mex. et Am. Cent., p. 105, pl. xx. f. 2.

Specimens were collected at Key West. I have seen others from the same locality collected by Dr. Packard, and from Tortugas (Lieut. Jacques). It has been reported from Antilles (Edw.), Cuba, Surinam, and Venezuela (Martens), Guadeloupe, St. Thomas, Martinique, Woman Key, Fla., and Cumana (A. Edw.).

Mithraculus cinctimanus Stm.

Mithraculus cinctimanus Stm., Am. Jour. Sci. and Arts. II., xxix. p. 132 (sine descr.); Ann. Lyc., vii. p. 186. A. M. Edw., Crust. Mex. et Am. Cent., p. 112, pl. xxiii. f. 3.

The twelve specimens of this species that I have examined agree well with Stimpson's description, except in the coloration of the hands. In these specimens (alcoholic), the hands are white with the basal two-thirds darker; there is also a band of darker on the fingers. Prof. Webster collected specimens at Plantation and Harbor Keys. In the Peabody Academy are specimens from Key West (Packard). Other localities are Tortugas (Stm.), St. Thomas (Stm., A. Edw.), Guadeloupe (A. M. Edw.).

Mithraculus hirsutipes Kingsley. Pl. xiv. f. 1.

Mithraculus hirsutipes Kingsley, Proc. Bost. Soc'y, xx. 147.

Two males were collected at Sarasota Bay, which agree well with my types, except in the comparatively narrower carapax.

Length of Carapax.	Breadth.	Ratio.
11 mm.	11.8 mm.	100 : 107
9 mm.	9.6 mm.	100 : 107

There were two young specimens collected at Sarasota Bay, which may be the young of either of the last two species. They differ, however, from *cinctimanus* in the absence of the large tooth at the base of the dactyli of the cheliped, and in having the ridge running backward from the palatal region broken; from *hirsutipes* in the smoother carapax, more prominent frontal horns, and in having the antennal spines as in *cinctimanus*, etc.

Genus **MITHRAX** Leach.**Mithrax spinosissimus** Edw.*Maia spinosissima* Lamarck, An. sans Vert., v. p. 241.*Mithrax spinosissimus* Edw., Mag. de Zool., ii. pls. ii. and iii.; Hist. Crust., i. p. 321.

Two young specimens from Key West. Other localities are Martinique, Antilles (M. Edw.), Key West (Gibbes), Florida Keys (Stm.), Cuba (Martens), Santa Cruz! (Charles Lawrence), Guadeloupe (Desbonne).

Mithrax hispidus Edw.*Cancer hispidus* Herbst, op. cit., pl. xviii. f. 100.*Maia spinicincta* Lamarck, op. cit., v. p. 241.*Mithrax spinicincta* Desmarest, op. cit., p. 150, pl. xxiii. f. 1, 2.*Mithrax hispidus* Edw., Mag. de Zool., ii.; Hist. Crust. i. p. 322. A.

M. Edw., Crust. Mex. et Am. Cent., p. 93, pl. xxi. f. 1.

Mithrax sp. Desbonne and Schr., op. cit., p. 8, pl. ii. f. 4 and 5.

Prof. Webster collected a single specimen of this well-known species at Key West. It has been reported from S. Carolina (Gibbes), Key Biscayne (Stm.), Key West! (Packard), Tortugas! (Lient. Jacques), Antilles (Edw.), Cuba (Martens), Guadeloupe (A. M. Edw., Desbonne, Saussure), Martinique (A. M. Edw.), Abrolhos, Brazil (Smith).

Mithrax pleuracanthus Stm.*Mithrax pleuracanthus* Stm., B. M. C. Z., ii. p. 116. A. M. Edw.,

Crust. Mex. et Am. Cent., p. 93, pl. xx. f. 3.

Specimens were collected at Sarasota Bay. Stimpson's types were from Key West and St. Thomas; Alphonse Milne Edwards had specimens from Martinique and Guadeloupe.

FAMILY **PARTHENOPIDÆ**.Sub-Family **Parthenopinæ**.Genus **PLATYLAMBRUS** Stm.**Platylambrus serratus** A. M. Edw.*Lambrus serratus* Edw., Hist. Crust., i. p. 357 (teste A. M. Edw.).*Lambrus crenulatus* Saussure, l. c., p. 13, pl. i. f. 4.*Platylambrus crenulatus* Stm., B. M. C. Z., ii. p. 129.*Platylambrus serratus* A. M. Edw., op. cit., p. 156, pl. xxx. f. 1.

A female was collected at Charlotte Harbor. (?) Indian Ocean (Edw.), Antilles (Saussure), Loggerhead Key and Tortugas (Stm.),

Cuba (von Martens), Vera Cruz (A. M. Edw.), Guadeloupe (Desbonne and A. M. Edw.).

M. Alphonse Milne Edwards considers this the same as the *Lambrus serratus* described by H. Milne Edwards, and the description applies well to the specimen now before me. Milne Edwards, Sr., gives the Indian Ocean as the habitat of *L. serratus*, and Adams and White (Voyage of the Samarang, Crustacea, p. 30, 1841) report it from the Philippine Islands.

Sub-Family **Cryptopodiinæ**.

Genus **HETEROCRYPTA** Stm.

Heterocrypta granulata Stm.

Cryptopodia granulata Gibbes, Proc. Am. Assoc., iii. p. 173; Proc. Elliot Soc'y, i. p. 36 (fig.).

Heterocrypta granulata Stm., Ann. Lyc., x. p. 102. A. M. Edw., Crust. Mex. et Am. Cent., p. 186, pl. xxix. f. 4.

Specimens were collected at Northampton Co., Va.; near Piver's Island, Beaufort, N. C., Florida Bay, and Sarasota Bay. Fort Macon! (Packard), Charleston, S. C. (Gibbes), St. Thomas (Stm., A. M. Edw.).

CANCROIDEA.

FAMILY **CANCRIDÆ**.

Sub-Family **Cancrinæ**.

Genus **CANCER** Leach (restr.).

Cancer irroratus Say.

Cancer irroratus Say, l. c., i. p. 59 (pars), pl. iv. f. 2.

Platycarcinus irroratus Edw., Hist. Crust., i. p. 414.

Cancer sayi Gould, Invert. Mass., p. 323.

Platycarcinus sayi Dekay, N. Y. Fauna Crust., p. 7.

Platycarcinus irroratus Dekay, op. cit., pl. ii. f. 2.

Cancer borealis Packard, Memoirs Bost. Soc'y, i. p. 303.

A young specimen was taken at Northampton Co., Va. It was rather more advanced than the form described by Prof. Smith (Fish Comm., p. 533); the length was 5 mm., breadth 6 mm.; the front is more produced, and the teeth of the anterolateral margin are more irregular than in the adult, but not to such an extent as in the younger form. I have not thought it worth while to enumerate all the reported localities for this species. I have examined specimens from Labrador (Packard), Eastport, Me. (Hyatt),

Casco Bay (Cooke), Is. of Shoals (R. H. Wheatland), Salem, Mass., Nantucket (Packard), Narragansett Bay, R. I., So. Shore, Long Island. Dr. Coues reports it from Fort Macon, Prof. Gibbs from Charleston Harbor, S. C., and Mr. Faxon writes me that there are specimens in the Museum of Comparative Zoology, at Cambridge, Mass., from Florida and Hayti (Dr. Weinland). In the Museum of the Peabody Academy of Science, Salem, Mass., is a fossil carapax of this species from the Post Pleiocene deposits of Gardiner, Maine.

Sub-Family *Xanthinæ*.

Genus *ACTÆA* De Haan.

Actæa spinifera, sp. nov.

Closely resembles *A. hirsutissima*, of the eastern seas, as figured and described by Rüppell¹ and Dana.² Carapax everywhere above areolate, more prominently so in front. Each areolet with small prominent rounded tubercles, which are covered with numerous stiff hairs, the spaces between the tubercles and between the areolets are smooth and naked; front with two depressed and produced lobes, the margins of which are armed with tuberculiform teeth; orbits with traces of two fissures above, spined above and below. Antero-lateral margins with five subequal teeth separated by rather deep grooves, the first three of which are continued on the under surface of the carapax; the teeth themselves have their margins armed with small spines. The postero lateral margin is strongly concave, as much so as in *A. hirsutissima*. Cheliped stout, of moderate length, inner surface of the joints smooth and naked, meros compressed, upper edge acute and haired, outer surface naked, upper and outer surfaces of carpus and hand with spiniform tubercles and stiff hairs, on the hand these tubercles tend to arrange themselves in rows; fingers short, stout, gaping, acute, black, their tips being white. Meral joints of the ambulatory feet compressed, upper margin acute, and terminating in an acute spine, sides smooth, remaining joints and posterior surface of the meros of the last pair with spines and hairs similar to those on the chelipeds; dactyli terminating in a small acute claw.

¹ Beschreibung und Abbildung von 24 Arten Kurzschwänzigen Krabben

* * * des rothen Meeres, Frankfurt, 1830, p. 26, pl. v. f. 6.

² U. S. Expl. Exped., p. 164, pl. viii. f. 3.

Abdomen and sternum granulate, the granulations being more prominent on the basal joints of the abdomen.

A single male was collected at Plantation Key, from which I derive the following measurements: Length, 14.2 mm.; breadth, 21 mm.; ratio, 100 : 148. This species is readily separated from all other North American species by the spines on the anterolateral teeth.

Actæa nodosa Stm.

Actæa nodosa Stm., Ann. Lyc., vii. p. 203. A. M. Edw., Nouv. Arch. du Mus., i. p. 266, pl. xvii. f. 6.

A specimen from Plantation Key affords the following measurements: Length, 17.5 mm.; breadth, 23.7 mm.; ratio, 100 : 135.

Tortugas (Stm.), Guadeloupe (Desbonne).

Genus **MENIPPE** De Haan.

Menippe mercenaria Stm.

Cancer mercenaria Say, l. c., i. p. 448.

Cancer (Xantho) mercenaria Edw., Hist. Crust., i. p. 399.

Pseudocarcinus ocellatus Edw., Hist. Crust., i. p. 409 (?).

Pseudocarcinus mercenaria Gibbes, Proc. Am. Assoc., iii. p. 176.

Menippe mercenaria Stm., Ann. Lyc., vii. p. 53.

Menippe ocellata Von Martens, l. c., xxxviii. p. 87.

Prof. Webster collected specimens of this well-known but synonymically abused species at Beaufort, N. C., Florida Bay, Plantation Key, Charlotte Harbor, Oyster Bay, Little Sarasota and Sarasota Bays.

Other localities are Fort Macon! (Coues, Packard), Charleston, S. C. (Gibbes), Key West! (Packard), Isthmus of Panama (Streets), Cuba (Martens). Mr. Faxon tells me there are specimens in the Museum of Comp. Zoology from Cuba (Poey), and Galveston, Texas (Boll).

Genus **PANOPEUS** M. Edw.

Panopeus herbstii Edw.

Cancer panope Say, Jour. Acad. Nat. Sci. Philadelphia, i. p. 58, pl. iv. f. 5 (nec Herbst).

Panopeus herbstii Edw., Hist. Crust., i. p. 403. Dekay, op. cit., p. 5, pl. ix. f. 26. Smith, Proc. Bost. Soc'y, xii. p. 276.

Occurs in this collection from Northampton Co., Va., Beaufort, N. C., Sarasota, Little Sarasota, Florida, and Oyster Bays, and Charlotte Harbor, Florida. Other localities are Fort Macon, N.

C.! (Packard), Bluffton, S. C.! (Dr. Mellichamp), Key West! (Packard), Aspinwall! (McNiel), Long Island Sound and Bahamas (Smith), Cuba (Martens), Rio Janeiro (Heller). According to Mr. Faxon there are specimens in the Museum of Comparative Zoology from Boston (Gould?, 1853) and Providence River, R. I.

***Panopeus packardii* Kingsley.**

Panopeus packardii Kingsley, Proc. Bost. Soc'y, xx. p. 152.

Specimens occur from Sarasota Bay, Harbor Key, and Charlotte Harbor, Fla. The majority of these specimens have the sinus between the angle of the orbit and the second normal tooth more shallow than did my types, which were from Key West (Packard).

***Panopeus texanus* Stimpson.**

Panopeus texanus Stm., Ann. Lyc., vii. p. 55.

Panopeus sayi Smith, Proc. Bost. Soc'y, xii. p. 284.

Specimens occur in the Union College collection from Northampton Co., Va., Beaufort, N. C., and Sarasota Bay, Fla. I have also seen specimens from Eastham, Mass. (W. C. Fish), Wood's Holl, Mass. (Packard, Verrill), New Haven, Conn. (Yale College). A careful examination of a large series has led me to unite these two forms, as I cannot find constant differences to separate them. There is all variation in the subhepatic tubercle, from one as prominent as typical specimens of *P. herbstii* to complete absence; the form of the anterolateral teeth varies, while the terminal segment of the male abdomen is the same in each form; in some the fingers of both hands were slender, some had them pointed on one hand and excavate on the other, while others had the fingers of both hands excavate. I am the more ready to unite them since Prof. Smith suggests their possible identity.

***Panopeus depressus* Smith.**

Panopeus depressus Smith, Proc. Bost. Soc'y, xii. p. 283; Fish Com., p. 547, pl. i. f. 3.

Specimens occur from Northampton County, Va., Beaufort, N. C., and Charlotte Harbor, Fla. Other localities are Provincetown, Mass. (Smith), New Haven! (Yale College), Maryland! (C. Cooke), West Florida! (Col. Jewett).

Genus EURYTIIUM Stm.

***Eurytium limosum* Stm.**

Cancer limosus Say, l. c., i. p. 446.

Panopeus limosus Edw., Hist. Crust., i. p. 404.

Eurytium limosum Stm., Ann. Lyc., vii. p. 56.

Prof. Webster collected specimens at Sarasota and Little Sarasota Bay, Fla. Other localities, New York (Dekay), So. Carolina (Gibbes, Stm.), Key West, Fla. (Packard), Smyrna, Fla. (Gibbes), Key Biscayne, Fla. (Stm.). Mr. Faxon tells me that there are specimens in the Museum of Comparative Zoology from Hayti (Dr. Weinland) and Brazil (Thayer Expedition).

Genus **CHLORODIUS** Leach.

Chlorodius floridanus Gibbes.

Chlorodius floridanus Gibbes, l. c., iii. p. 175.

Leptodius floridanus A. M. Edw., Hist. Crust. Fossiles, i. p. 228.

But a single specimen of this common species was collected by Prof. Webster, at Plantation Key, Fla. I have examined others from Key West! (Packard), Aspinwall! (McNiel), and Abrolhos, Brazil! (Hartt).

Chlorodius longimanus M. Edw.

Chlorodius longimanus M. Edw., Hist. Crust., i. p. 401.

A single specimen was collected at Key West, by Prof. Webster.

I have seen others from the same locality collected by Dr. A. S. Packard, which differ from Edwards's description in having the meros of the chelipeds armed with five distant tuberculiform teeth. Edwards's specimens were from Porto Rico.

Chlorodius dispar Stm.

Chlorodius dispar Stm., B. M. C. Z., ii. p. 140.

Eighteen specimens were collected at Key West, and as they show a considerable range of variation, I give a description of a specimen varying most widely from Stimpson's type.

Carapax transversely oval, very broad, smooth, naked; antero-lateral margin almost entire, the three last teeth alone showing, and they but very slightly. Front sinuate, four lobed, resembling that of *Panopeus herbstii*, a straight fringe of hairs above the margin. Orbits entire above and below, the inner inferior angle prominent. Chelipeds long, about equal in length, but differing greatly in diameter, the right being usually the larger. Fingers of the larger about half the length of the palm, short, stout, gaping, with the extremities acute, not at all excavate. Smaller cheliped, with the carpus and propodus polished and deeply punctate. Hand long, no stouter than the preceding joint, subcylindrical, fingers about half as long as the palm, closing completely,

and spoon excavate. Smaller specimens agree perfectly with Stimpson's description, while the smallest specimen has all the antero-lateral teeth obsolete.

Sex.	Length of Carapax.	Breadth.	Ratio.
♂	7.8 mm.	13.2 mm.	100 : 169
♂	3.9 mm.	5.5 mm.	100 : 149

Stimpson's types, two in number, were from Cruz del Padre, Cuba.

FAMILY ERIPHIDÆ Dana.

Sub-Family Oziinæ Dana.

Genus *HETERACTÆA* Lockington.¹

In the two species which I have examined the following characters may be noted. Form similar to that of *Pilumnus*, which it closely resembles in the antennæ and external maxillipeds. It, however, differs in the absence of a palatal ridge and in the curious naked crests on the meral joints of the ambulatory feet. The orbits have the external hiatus more or less distinct, and below have two lobes. It forms one of these synthetic forms, which like *Xanthodius*, *Eurytium*, *Eurycarcinus*, *Pilumnopeus*, *Micropanope*, etc., combine the characters of both Cancroid and Eriphioid Crustacea. The type is *Heteractæa lunata*.²

Heteractæa ceratopus Kingsley.

Pilumnus ceratopus Stm., Ann. Lyc., vii. p. 215.

Pilumnus sp. Desbonne et Schramm., op. cit., p. 33, pl. iii. f. 9-10.

A male was collected at Key West, Fla. Key Biscayne, Fla. (Stimpson), Guadeloupe (Desbonne).

Genus *PILUMNUS* Leach.

Pilumnus aculeatus M. Edw.

Cancer aculeatus Say, l. c., i. p. 449.

Pilumnus aculeatus Guérin, Iconog. Regne Animal, Crust., pl. iii. f. 2.

Edw. Hist. Nat. Crust., i. p. 420. Gray, in Griffith's Cuvier, vol. 13, pl. iv. f. 2, 1833. Martens, l. c., xxxviii. p. 91, pl. iv. f. 6.

¹ Proceedings of the California Academy of Sciences, vol. vii. p. 97, 1876.

² *Heteractæa lunata* Kingsley.

Pilumnus lunatus Edwards et Lucas in D'Orbigny's Voyage dans l'Amérique Meridionale, Crustaces, p. 20, pl. ix. f. 2.

Heteractæa pilosa Lockington, Proc. Cal. Acad., vii. p. 97.

Gulf of California! (Fisher), C. St. Lucas and Central America (Stimpson), Chili (Edw. et Lucas, Nicolle).

Specimens were collected at Sarasota Bay and Marcou Pass.

Pilumnus dasypodus Kingsley.

Pilumnus dasypodus Kingsley, Proc. Bost. Soc'y, xx. p. 155.

Harbor Key and Sarasota Bay, Fla. My types were from Key West.

Pilumnus gemmatus Stm.

Pilumnus gemmatus Stm., Ann. Lyc., vii. p. 214.

Specimens were collected at Plantation and Harbor Keys, Charlotte Harbor, and Florida Bay. I have seen others from Key West (Packard). Stimpson's types were from St. Thomas.

Genus **EUPILUMNUS** (nov.).

Carapax depressed. Basal joints of antennæ as in *Pilumnus*. External maxillipeds with the meral joint short and narrow, it being only about two-thirds as wide as ischial joint, which is short and broad.

Eupilumnus websteri, sp. n., plate xiv. f. 3.

Carapax depressed, nearly flat, regions not indicated, above with a short, sparse pubescence, front slightly arcuate, the margin with fine spiniform teeth. Orbits above smooth, not toothed. External angle spiniform, below with spines near the inner angle. Antero-lateral margin with three prominent spiniform teeth, with smaller ones between them, several small spines on the hepatic region, and one on the branchial behind the lateral teeth. Anterior margin of palate spined. The chelipeds are lacking in the single specimen. Ambulatory feet compressed, spined above, dactyli short, curved, spined below.

Key West, Fla. Length, 6 mm.; breadth, 8.1; ratio, 100 : 135.

Sub-Family **Eriphiinæ** Dana.

Genus **ERIPHIA** Latreille.

Eriphia gonagra M. Edw.

Cancer gonagra Fabr., Suppl. Ent. Syst., p. 337.

Eriphia gonagra Edw., Hist. Crust., i. p. 426, pl. xvi. f. 16, 17.

Specimens were collected at Plantation Key, Fla. Other localities are Key West! (Packard), Tortugas (Stm.), Florida Keys, Bahamas (Smith), Aspinwall! (McNiel), Abrolhos, Brazil! (Hartt), Rio Janeiro (Dana, Heller), Cuba (von Martens), Jamaica et Carolina (Bosc).

FAMILY **PORTUNIDÆ**.Sub-Family **Lupinæ**.Genus **ACHELOUS** De Haan, Stm.**Achelous spinimanus** De Haan.*Portunus spinimanus* Latr., Encyc. Methodique, x. p. 189.*Lupa spinimana* Desmarest, op. cit., p. 98. Edw., Hist. Nat. Crust., i. p. 452.*Achelous spinimanus* De Haan, Fauna Japonica Crust., p. 8. A. M. Edw., Archives du Museum, x. p. 341, pl. xxxii. f. 1.

Little Sarasota Bay.

Achelous gibbesii Stm.*Lupa gibbesii* Stm., Ann. Lyc., vii. p. 57.*Achelous gibbesii* Stm., Ann. Lyc., vii. p. 222.*Neptunus gibbesii*, A. M. Edw., Nouv. Archives du Museum, x. p. 326, pl. xxxi. f. 1.

Beaufort, N. C.; Oyster Bay and Sarasota Bay, Fla. The range of this species so far as known is included within the limits of the above localities.

Genus **CALLINECTES** Stm.**Callinectes hastatus** Ordway.*Lupa hastata* Say, l. c., i. p. 65.*Lupa diacantha* Dekay, op. cit., p. 10, pl. iii. f. 3.*Callinectes hastatus* Ordway, Jour. Bost. Soc'y, vii. p. 568.

Three sterile females were collected at Beaufort, N. C.

Genus **NEPTUNUS** De Haan.**Neptunus sayi** Stm.*Portunus pelagicus*, Bosc, Hist. Nat. Crust., edit. i. t. i. p. 220, pl. v. f. 3 (teste A. Edw.), edit. ii. t. i. p. 235, pl. v. f. 3 (non Linne).*Lupa pelagica* Say, Jour. Acad. Nat. Sci., i. p. 97. Dekay, op. cit., p. 11, pl. vi. f. 8.*Lupa sayi* Gibbes, l. c., iii. p. 178. Dana, op. cit., p. 273, pl. xvi. f. 8.*Neptunus sayi* Stm., Ann. Lyc., vii. p. 92. A. M. Edw., Arch. du Mus. x. p. 317, pl. xxix. f. 2.

Plantation Key, Fla.

FAMILY **PLATYONICHIDÆ**.Genus **CARCINUS** Leach.**Carcinus maenas** Leach.*Cancer maenas* Linne, Syst. Nat., edit. xii. p. 1043. Herbst, pl. vii. f. 46.*Portunus maenas* Leach, Edinburg, Encyclopedia, vii. p. 390 (teste Bell).

Carcinus manas Leach, op. cit., vii. p. 429 (teste Auct.); Malacos.

Podophth. Brit., pl. v. f. 1-4. Dekay, op. cit., p. 8, pl. v. f. 5-6.

Alph. M. Edw., Arch. du Mus., x. p. 391.

Cancer granulatus Say, l. c., i. 61.

Carcinus granulatus Smith, Fish Comm., p. 547.

A single male from Northampton Co., Va. This is the farthest south on the Atlantic coast of the United States from which this species has been reported.

Genus **PLATYONICHUS** Latreille.

Platyonichus ocellatus (Herbst sp.) Latreille.

Portunus pictus Say.

Beach of Chesapeake Bay, opposite Fort Monroe. Mr. James Hector (Trans. New Zealand Inst., ix. p. 473, pl. xxviii. f. 1, 1877) reports this species from Wellington, New Zealand.

OCYPODOIDEA.

FAMILY **CARCINOPLACIDÆ.**

Genus **EURYPLAX.**

Euryplax nitida Stm.

Euryplax nitida Stm., Ann. Lyc., vii. p. 60; B. M. C. Z., ii. p. 150.

Smith, Trans. Conn. Acad., ii. p. 162.

Specimens collected by Prof. Webster, at Sarasota Bay, Fla., have the front slightly arcuate with a slight sinus at the middle, but not emarginate. The carpi of the chelipeds are not flattened. Otherwise the specimens agree perfectly with the descriptions quoted above. Proportions of a male: length, 14.7 mm.; breadth, 23.5 mm.; ratio, 100:160. There is a single specimen in the Museum of the Peabody Academy of Science, which came with *Platyonichus ocellatus*, *Squilla empusa*, and two or three other species with the label New Orleans. Other localities are Florida Keys and St. Thomas (Stm.), Egmont Key, Fla. (Smith).

FAMILY **OCYPODIDÆ.**

Genus **GELASIMUS** Latr.

Gelasimus minax Le Conte.

Northampton Co., Va.

Gelasimus pugillator (Bosc sp.) Latreille.

Beaufort, N. C., and Sarasota Bay, Fla.

Gelasimus vocator (Herbst) Martens.

Northampton Co., Virginia; Fort Macon, N. C., and Sarasota Bay, Fla.

Genus **OCYPODA**.

Ocypoda arenaria Say.

Beach of Chesapeake Bay, opposite Fortress Monroe, and Sarasota Bay, Florida.

FAMILY **GRAPSIDÆ**.

Sub-Family **Grapsinæ**.

Genus **GONIOPSIS** De Haan, Edw.

Goniopsis cruentatus De Haan.

Cancer ruricola De Geer, Mémoires pour servir à l'Histoire des Insectes, vii. p. 417, pl. xxv. (non Linne).

Grapsus cruentatus Latreille, Hist. Crust. et Insectes, vi. p. 70. Edw., Hist. Crust., ii. p. 85.

Grapsus longipes Randall, l. c., vii. p. 125.

Goniopsis cruentatus De Haan, Fauna Japonica, p. 33. Edw., Am. Sci. Nat. III., xx. p. 164, pl. vii. f. 2.

Goniopsis ruricola White, List Crust. Brit. Museum, p. 40. Saussure, op. cit., p. 30, pl. ii. f. 18.

Goniograpsus cruentatus Dana, U. S. Expl. Exped. Crust., p. 342, pl. xxi. f. 7.

Grapsus (Goniopsis) cruentatus von Martens, l. c., xxxviii. p. 105.

A male was collected at Sarasota Bay. Other localities are Florida Keys (Smith), Cuba (Saussure, Martens), Antilles, Brazil (M. Edw.), Guadeloupe (Desbonne), Surinam (Randall), Venezuela, Liberia (Martens), Abrolhos, Brazil (Smith), Rio Janeiro (Dana, Heller), ? Gulf of Fonseca, west coast of Nicaragua (Smith).

Genus **PACHYGRAPSUS** Randall.

Pachygrapsus transversus Gibbs.

Grapsus transversus Gibbs, l. c., iii. p. 181.

Pachygrapsus transversus Gibbs, l. c., p. 182. Kingsley, Proc. Bost. Soc'y, xx. p. 158.

Metopograpsus dubius Saussure, op. cit., p. 29, pl. ii. f. 16.

Metopograpsus miniatus Saussure, op. cit., p. 28, pl. ii. f. 17.

Grapsus (Leptograpsus) rugulosus Martens, l. c., xxxviii. p. 108.

Grapsus (Leptograpsus) miniatus Martens, l. c., xxxviii. p. 109.

Sarasota Bay. Other localities are Florida Keys and Texas (Stm.), Key West! (Packard, Gibbs), St. Thomas (Saussure),

Cuba (Martens), Gulf of Fonseca, west coast Nicaragua! (McNiel), Panama (Smith).

Genus **GRAPSUS** Lamarek.

Grapsus maculatus Edw.

Pagurus maculatus Catesby, Natural History of the Carolinas, ii. pl. xxxvi. f. 1. 2d edit., l. c.

Cancer grapsus Fabr., Suppl., p. 342.

Grapsus pictus Latr., Hist. Crust. et Ins., vi. p. 69, pl. 47, f. 2.

Goniopsis pictus De Haan, Fauna Japonica, Crustacea, p. 33 (1833).

Grapsus maculatus M. Edw., Am. Sci. Nat. III., xx. p. 167, pl. vi. f. 6.

Grapsus altifrons Stm., Ann. Lyc., vii. p. 230.

Specimens were collected at Plantation Key, Fla. According to Martens, the *Cancer tenuicristata* of Herbst, on examination of his types, proves to be *Grapsus rudis*, Edw., from the East Indies.

Santa Cruz! (Charles, Lawrence), Cuba (Saussure, Martens), Guadeloupe (Desbonne), Tortugas (Stm.), Madiera, Cape Verdes, Peru, Paumotu Is., Sandwich Is. (Dana), C. St. Lucas (Stm.), Mazatlan (Saussure), Gallapagos Is. (Miers), Chili (Nicolet), Tahiti! (A. Garrett).

Genus **PLAGUSIA** Latreille, Miers.

The species of this genus have been recently revised by Mr. Miers (Ann. and Mag. Nat. Hist., Feb. 1878, pp. 147-154).

Plagusia depressa Say.

?*Cancer depressus* Fabr.; ?*Cancer squamosus* Herbst; *Plagusia sayi* Dekay; *Plagusia squamosa* Latr.; *Plagusia gracilis* Sauss.

A single specimen (length 42.2, breadth 45.2 mm.) was found at Plantation Key.

Sub-Family **Sesarminæ**.

Genus **SESARMA** Say.

Sesarma cinerea Say.

Grapsus cinereus Bosc, op. cit., edit. 1, p. 204, pl. v. f. 1 (teste auct.).

Sesarma cinerea, Say, l. c., i. p. 442 (non *Grapsus cinereus*, p. 99), Edw., Hist. Crust., ii. p. 75.

Northampton Co., Va., Beaufort, N. C., Sarasota and Little Sarasota Bays, Florida.

Sesarma reticulata Say.

Sesarma reticulata Say, l. c., i. pp. 73, 76, 442, pl. iv. f. 6; Edw., Ann. Sci. Nat., III. xx. 182.

Sesarma cinerea Dekay, op. cit., p. 15.

Northampton Co., Va., and Little Sarasota Bay, Fla.

Genus **ARATUS**.**Aratus pisonii** M. Edw.*Sesarma pisonii* M. Edw., Hist. Crust., ii. p. 76, pl. xix. f. 4-6.*Aratus pisonii* M. Edw., Ann. Sci. Nat., II. xx. p. 187; Stm., Ann. Lyc., vii. p. 232.*Sesarma (Aratus) pisonis* von Martens, Wieg. Arch., xxxv. p. 12, pl. 1, f. 4 (1869); id., xxxviii. p. 111.

Specimens were collected at Sarasota Bay, Florida. It ranges south to Rio Janeiro (Heller). I am unable to separate specimens from the west coast of Nicaragua (McNeil) from the east coast forms.

FAMILY **PINNOTHERIDÆ**.Genus **PINNOTHERES**.**Pinnotheres ostreum** Say.*Pinnotheres ostreum* Say, l. c., i. p. 67, pl. iv. f. 5.

Beaufort, N. C.

Pinnotheres maculatus.*Pinnotheres maculatus* Say, l. c., i. p. 450.*Pinnotheres ostreum* Smith, Fish Commission, pl. i. f. 2.

Beaufort and Morehead Depot, N. C.

Genus **PINNIXA** White.**Pinnixa cylindrica** White.*Pinnotheres cylindrica* Say, l. c., i. p. 452.*Pinnixa cylindrica* White, List Crust. Brit. Mus., p. 33; Ann. and Mag. Nat. Hist., xviii. p. 177; Smith, Fish Comm., p. 546, pl. 1, f. i.*Pinnixa lævigata* Stm., Ann. Lyc., vii. p. 68.

Specimens were collected at Florida and Sarasota Bays, Fla. It has previously been known from Vineyard Sound (Smith) to South Carolina (Stimp.).

Pinnixa chætopterana Stm.*Pinnixa cylindrica* Stm., Ann. Lyc., vii. p. 68 (non Say).*Pinnixa chætopterana* Stm., Ann. Lyc., vii. p. 235.

Eastern shore Virginia, Beaufort, N. C., and Florida Bay, Fla.

LEUCOSOIDEA.

FAMILY **CALAPPIDÆ**.Genus **CALAPPA** Fabr.**Calappa marmorata** Fabr.*Calappa marmorata* Fabr., Suppl. Ent. Syst. p. 346; M. Edw., Hist. Crust. ii. p. 104.

Prof. Webster collected specimens at Beaufort, N. C., Key West, and Sarasota Bay, Fla. Other localities are Antilles (Auct.), Pensacola, Tortugas, and Key West (Stm.), Charleston, S. C. (Gibbes), Cuba (Martens), Bermudas (Goode), Guadeloupe (Desborne). Mr Faxon tells me he has taken specimens at Newport, R. I.

FAMILY MATUTIDÆ.

Genus **HEPATUS** Latreille.

Hepatus decorus Gibbes.

Cancer decorus Harbst, op. cit., p. 154, pl. xxxvii. f. 6.

Hepatus decorus Gibbes, Proc. Am. Assoc., iii. p. 183.

Hepatus vanbenedeni Herklots, Bidjr. tot de Dierkunde, I. p. 35, pl. 1, f. 1 (1852).

Specimens were collected at Beaufort, N. C., Charlotte Harbor, Marcou Pass, and Sarasota Bay, Fla. Dr. Stimpson suggests a comparison of the young of this species with *H. tuberculatus* Saussure, but, on examination, the difference is as great as in the adult.

FAMILY LEUCOSIDÆ.

Sub-Family **Ilinæ**.

Genus **PERSEPHONE**.

Persephone punctata Stm.

Cancer punctata Brown, Natural History of Jamaica, pl. 42, f. 3.

Persephone latreillei et *P. lamarekii* Leach, Zool. Mis., iii. p. 22.

Guaia punctata Edw., Hist. Crust., ii. p. 127.

Persephone guaia Bell, Trans. Linn. Soc'y, xx. p. 292.

Persephone punctata Stm., Ann. N. Y. Lyc., vii. p. 70.

Beaufort, N. C., Sarasota and Florida Bays, Fla.

Sub-Family **Eballinæ**.

Genus **LITHADIA**.

Lithadia cariosa Stm.

Lithadia cariosa Stm., Ann. Lyc., vii. p. 238.

Beaufort, N. C., Harbor Key, Fla., and Sarasota Bay, Florida. The Floridan forms have a less irregular carapax, but otherwise I can detect no difference.

Lithadia lacunosa, sp. n.

Carapax convex, with small circular depressions, similar in form and appearance to those on a lady's thimble. Closely re-

sembling *L. cariosa* in form. Inner portions of branchial and cardiac regions moderately protuberant. Hepatic region but slightly excavate, the ridge crossing it being broad, low, and rounded, otherwise as in *L. cariosa*. Front elevated, and connected with cardiac region by a broad rounded ridge (in *cariosa* this ridge is narrow and more abrupt); a small tooth on the postero-lateral margin. The sulcus separating the cardiac from the branchial region is well marked, but not so much as in *cariosa*. Chelipeds with small tubercles. Abdomen of the male with a strong tooth directed backward, arising from the proximal margin of the penult joint.

A male from Sarasota Bay gives the following measurements: Length of carapax 9.7 mm., breadth 11.1 mm., ratio 100 : 135.

This species differs from *cariosa* in the broader carapax, the ornamentation, and more even surface; from *pontifera* in lacking the "bridged" fossæ between the cardiac and brachial regions; from *cadaverosa* in more even carapax and ornamentation, and in having but one tooth on the antero-lateral margin; from *cubensia* in having the meros of the chelipeds subcylindrical, and not expanded behind.

DROMIOIDEA.

FAMILY DROMIIDÆ.

Genus DROMIDIA Stm.

Dromidia antillensis Stm.

Dromidia antillensis Stm., Proc. Phila. Acad., 1858, p. 225; Ann. Lyc. vii. p. 71.

A single specimen from Key West. Other localities are Tortugas and Key Biscayne (Stm.), St. Thomas, and Abrolhos, Brazil (Smith).

Genus HYPOCONCHA Guerin.

Hypoconcha arcuata Stm.

Hypoconcha arcuata Stm., Proc. Phila. Acad., 1858, p. 226; Ann. Lyc., vii. p. 72.

Professor Webster collected specimens at Florida and Sarasota Bays. I have seen others from Key West (A. S. Packard, Jr.). Stimpson had specimens from South Carolina and St. Thomas. It seems to me that both Guerin and Stimpson are right in explaining the manner in which this crab holds the protecting shell,

that the two posterior pairs of feet and the projecting abdomen each do their part.

PORCELLANOIDEA.

FAMILY POCELLANIDÆ.

Genus **PETROLISTHES** Stm.¹

Petrolisthes sexpinosus Stm.

Porcellana galathina Say, l. c., i. p. 458? (non Bosc).

Porcellana sexspinosa Gibbes, Proc. Am. Assoc., iii. p. 190.

Petrolisthes sexpinosus Stm., Proc. Phila. Acad., 1858, p. 227.

Professor Webster collected specimens at Key West, Harbor Key, Florida Bay, and Sarasota Bay.

I am inclined to follow Stimpson in supposing that this is not the *Porcellana galathina* of Bosc, as it differs considerably from his figure, which represents a species with smaller hands, shorter fingers, the ridges of the carapax different, while the carapax itself is nothing like that of this species. This species has been reported from Georgia and Florida (Say), South Carolina and Key West (Gibbes) and Florida Keys (Stm.).

Petrolisthes jugosus Streets.

Petrolisthes jugosus Streets, l. c., 1872, p. 134.

I refer, with a doubt, a single specimen collected at Key West to this species, as it presents the following points of difference from Dr. Streets' description: The lobes of the front are indistinct. (The right hand is missing.) The posterior border of the hand is not pubescent, and there is no trace of a furrow on the upper portion of the hand; the anterior margin of the carpus has four teeth. In every other respect it agrees perfectly. Dr. Streets' specimens came from the Island of St. Martins, W. I.

¹ I would here straighten the synonymy of two species of this genus—

Petrolisthes danae.

Porcellana bosii Dana, U. S. Expl. Exped. Crust., p. 421, pl. xxvi. f. 2 (non Savigny).

Porcellana danae Gibbes, Proc. Elliot Soc'y, i. p. 11.

Petrolisthes braziliensis Smith, Trans. Conn. Acad., ii. p. 38.

Rio Janeiro (Dana).

Petrolisthes Helleri.

Porcellana danae Heller, Reise der Oesterreich Fregatte Novara, Crustaceen, p. 74 (non Gibbes).

Nicobars (Heller).

Petrolisthes armatus Stm.

Porcellana armata Gibbes, Proc. Am. Assoc., iii. p. 90; Proc. Elliot Soc'y, i. f. 11, pl. i: f. 4; Martens' Wieg. Arch., xxxviii. p. 121, pl. v. f. 11.

Petrolisthes armatus Stm., Proc. Phila. Acad., 1858, p. 227, vii. p. 73.

Specimens were collected at Sarasota, Charlotte, and Florida Bays. Other localities are Key West! (Packard), Florida (Gibbes), Aspinwall, St. Thomas, and Panama (Stm.), Cuba (Martens), Fonseca, west coast Nicaragua! (McNiel), Gulf of California (Lockington).

Dr. von Martens quotes *P. galathina* Bosc as a synonym of this species, which is surely erroneous.

Genus PISOSOMA Stm.**Pisosoma glabra**, sp. n. Plate xiv. fig. 2.

Carapax convex, a little broader than long, polished, microscopically punctate. Front advanced, broad, three lobed, the median lobe being slightly more advanced than the lateral ones. Antennæ about twice as long as the carapax, the basal joints similar to those of *Petrolisthes*. Chelipeds short, stout; meros subcubical, its anterior margin distally armed with an acute tooth directed toward the carpus; carpus stout, broader than long, its anterior margin expanded, with a strong tooth on the proximal portion, the remainder with rounded teeth, the posterior portion of the upper surface is roughened, and the posterior margin distally armed with minute rounded teeth. Hand twice as long as broad, microscopically granulate, a shallow sulcus on the posterior portion of the palm producing a cristate appearance of the posterior margin; fingers not so long as palm, completely closing, the dactylus with a shallow groove above. Beneath, the chelipeds are smooth and polished. Ambulatory feet sub-cylindrical, hairy above. This species differs from Stimpson's description of his imperfect specimen of *P. riisei* in the simple, not bimarginate character of the front, etc.

Five specimens were collected at Key West.

Length of carapax 4.1 mm., breadth 4.5 mm., ratio 100 : 110.

Genus PORCELLANA Lamarck, Stimpson.**Porcellana pilosa** Edw.

Porcellana pilosa Edw., Hist. Crust., ii. p. 255.

Carapax longitudinally convex, surface even, and covered with

short stiff hairs arranged in transverse rows. Front advanced, three-lobed, median lobe projecting beyond the others. Chelipeds short, stout, unequal, and clothed above with a short pubescence, interspersed in which are stiff hairs, similar to those of the carapax. Carpus short, length and breadth about equal, the inner margin expanded, and armed with four or five acute teeth. Hands short and broad, almost sub-chelate, the thumb being very short, and the dactylus strongly curved. Ambulatory feet with pubescence and hairs similar to those on the carapax.

Specimens were collected at Sarasota Bay and Key West.

Length of Carapax.	Breadth.	Ratio.
4 mm.	5.1 mm.	100 : 128
6 mm.	6.2 mm.	100 : 103

Edwards's specimens were from Charleston, S. C.

Porcellana sayana.

Pisidia sayana Leach, Dict. Sci. Nat., xviii. p. 54.

Porcellana ocellata Gibbes, Proc. Am. Assoc., iii. p. 190. Ibid., Proc.

Elliot Soc., i. p. 12, pl. i. f. 2.

Quite a number appear in this collection from Sarasota Bay. Gibbes' types came from South Carolina; Stimpson reports it from Fort Macon, N. C., Florida Keys, and St. Thomas.

At my request Mr. Edward J. Miers very kindly examined Leach's type in the British Museum, which was sent by Say under the name *Porcellana galathina*. He says: "Leach's specimens of *Porcellana (Pisidia) sayana* are certainly not referable to *P. sexspinosa*, as described by Gibbes, but appear to belong to *P. ocellata* of the same author. They agree well with Gibbes' description and with specimens of *P. ocellata* received by the British Museum from the Smithsonian Institution, differing only in being of smaller size and in no longer presenting any traces of the pink reticulations."

Porcellana sociata Say.

Porcellana soriata Say, Journ. Phila. Acad., i. p. 456.

Pisidia socta Leach, Dict. Sci. Nat., xviii. p. 54.

Porcellana sociata Gibbes, Proc. A. A. A. S., iii. p. 190. Ibid., Proc.

Elliot Soc., i. p. 12, pl. i. f. 6.

Professor Webster collected specimens at Florida Bay and Harbor Key. Other localities are Fort Macon (Stm.), South Carolina, and Key West (Gibbes), Georgia, and Florida (Say, Leach).

Genus **POLYONYX** Stm.**Polyonyx macrocheles** Stm.

Porcellana macrocheles Gibbes, Proc. Am. Assoc., iii. p. 191. Ibid., Proc. Elliot Soc., i. p. 6, pl. i. f. 5.

Polyonyx macrocheles Stm., Proc. Phila. Acad., 1858, p. 229. Faxon, B. M. C. Z., v. 256, pls. II. and III. (Development).

In this species the males are smaller, with a narrower carapax and with the chelipeds proportionately longer than in the female, as will be seen by the following measurements:—

Locality.	Sex.	Length.	Breadth.	Ratio.	Length of Larger Hand.
Sarasota Bay	♀	8.2 mm.	13.2 mm.	100 : 161	23.2
"	♀	7.5 mm.	12 mm.	100 : 160	22
"	♂	5.5 mm.	7.6 mm.	100 : 138	20.4
"	♂	6.4 mm.	9.2 mm.	100 : 144	24.5
Beaufort, N. C.	♂	6 mm.	9 mm.	100 : 150	23.7

According to Prof. Webster's labels, this species was found at Beaufort, N. C., and Shark Shoal, N. C., in tubes of *Chætopterus*, as was noticed by Stimpson. Stimpson and Gibbes had specimens from South Carolina. Newport, R. I. (Faxon).

Genus **EUCERAMUS** Stm.**Euceramus prælongus** Stm. Plate xiv. fig. 4.

Euceramus prælongus Stm., Am. Journ. Sci. and Arts, II. xxix. p. 445.

Professor Webster obtained specimens of this curious crustacean at Beaufort, N. C. (7 faths.), and Florida and Sarasota Bays, Fla., from which the following description is drawn:—

Carapax nearly cylindrical, the sides but slightly arcuate; surface even, with minute transverse striæ, which curve forward on the sides. Front, between the eyes, about one-third the width of carapax, three toothed, median tooth longer and projecting further than the laterals. There is a slight excavation of the anterior margin over the eyes and antennæ. A minute acute spine at the antero-lateral angle, and a little posterior to this is a slight emargination of the lateral margin. Eyes minute, but little prominent.

Antennal flagella about three-fourths the length of the carapax. Feet stout; chelipeds stout; hands slightly roughened, fingers about as long as the palm, not gaping; second pair shorter than the third and fourth; fifth pair small, and curved in the same manner as in the other *Porcellanidæ*. Terminal segment of ab-

domen and its appendages resembling those of the allied genera, but narrower. Length of carapax 12 mm., breadth 6 mm., ratio 100:50.

Genus **HIPPA** Fabr., Edw.

Hippa emerita Fabr.

?*Cancer emerita* Linne, Syst. Nat. Ed., xii. p. 1055.

Cancer testudinarius Herbst, pl. xxii. f. 3.

Hippa emerita [us] Fabr., Suppl. Ent. Syst., p. 370. Desmarest Consid., p. 174, pl. xxix. f. 2. Edw. Hist. Crust., ii. p. 209. Dana, U. S. Ex. Crust., p. 409, pl. xxv. f. 9. Miers, Journ. Linn. Soc., xiv. p. 313, pl. v. f. 9.

Hippa talpoida Say, l. c., i. p. 160. Dekay, op. cit., p. 18, pl. vii. f. 17. Smith, U. S. Fish Comm., p. 548, pl. ii. f. 5. Ibid., Trans. Conn. Acad., iii. p. 311.

In the Union College collection appear specimens from the beach of Chesapeake Bay opposite Fort Monroe, Beaufort, N. C., Sarasota Bay, Fla. Specimens from the first locality measure 26 mm. in length of carapax. Mr. Miers has made a mistake in quoting Prof. Gibbes, as this species does not occur at Boston except in collections.

Cape Cod to Florida (Smith), Venezuela (Miers), Cuba and Mexico (Guerin), Rio Janerio (Dura, Heller, Miers), Corinto, West Coast Nicaragua! (McNiel). These specimens are certainly *H. emerita*, and not *H. analoga*, Stm.

FAMILY **ALBUNEIDÆ**.

Genus **ALBUNEA** Fabr., Stm.

Albunea paretii Guerin.

Albunea paretii Guerin, Revue et Magazin de Zoologie, II. v. p. 48, pl. i. f. 10.

Albunea oxyophthalma Leach (MS.), White, List Crust. Brit. Museum, p. 57 (sine descr., teste Miers). Miers, Journ. Linn. Soc., xiv. p. 329, pl. v. f. 14-15.

A single specimen from Sarasota Bay agrees with Mr. Miers's description and figures, except that the median emargination is less deep and the lateral portion of the front more advanced and more curved, the eyes also appear to be rather more slender. It agrees well with Guerin's short description, and, as his was the first published description, his name will of course hold. Miers gives as localities St. Christophers, Cayenne, and Brazil. Guerin was not certain of the locality of his specimens, they were either

from Genoa or America. His types do not exist in the collection of the Philadelphia Academy.

Genus **LEPIDOPS** Stm.

Lepidops venusta Stm.

Lepidops venusta Stm., Proc. Phila. Acad., 1858, p. 230. Ibid., Ann. Lyc., vii. p. 79. Miers, Journ. Linn. Soc., xiv. p. 332.

A single specimen, which I refer without a doubt to this species, was dug up on the beach near Fort Macon, N. C. It agrees well with Stimpson's description, and certainly is not *L. scutellata*, from which it differs in the shape of the eyes, the form of the front, the dactyli of the second pair of feet, etc. Stimpson's type was from St. Thomas.

PAGURIOIDEA.

Professor Webster collected a large number of specimens belonging to this sub-order, but I am unable to report on them.

THALASSINOIDEA.

FAMILY GEBIDÆ.

Genus **GEBIA**.

Gebia affinis Say

Gebia affinis Say, l. c., i. p. 241. Smith, Fish Comm., p. 549, pl. ii. f. 7.

Specimens were collected at Beaufort, N. C., and Sarasota Bay, Fla. Long Island Sound to South Carolina (Smith), Charleston, S. C. (Gibbes).

FAMILY CALLIANASSIDÆ.

Genus **CALLIANASSA**.

Callianassa stimpsoni Smith.

Callianassa stimpsoni Smith, Fish Comm., 1871-2, p. 549, pl. ii. f. 8.

Professor Webster collected specimens at Beaufort, N. C., and Northampton County, Va., Atlantic side. Southern States to Long Island Sound (Smith).

ASTACOIDEA.

FAMILY PALINURIDÆ.

Genus **PANULIRUS** Gray.

Panulirus americanus Streets.

Palinurus americanus Lamarck, Ms.; Edw., Hist. Crust., ii. p. 298.

Panulirus americanus Streets, l. c., 1871, p. 242.

A single specimen was collected at Plantation Key, Fla., Antilles (Edw.), Key West (Gibbes), Isthmus of Panama (Streets).

I give below a revision of the genera of *Caridea* belonging to the families *Crangonidæ*, *Atyidæ*, and *Palæmonidæ*. It is founded on the arrangement of Dana. The genera of which I have seen specimens I have designated by the letter "o." As I have recently published a synonymical list of the North American Shrimps (Bulletin Essex Institute, x. pp. 53-71, 1878), I have refrained in most cases from giving the synonymy of the species collected by Prof. Webster.

CARIDEA.

Body generally laterally compressed, the carapax not united to the epistome, usually a broad lamelliform appendage (antennal scale) on the basal joint of the antennæ, sometimes, however, it is wanting; antennulæ bi- or tri-flagellate; mandibles varying in form, sometimes with, sometimes without a palpus; external maxillipeds generally pediform; feet generally long and slender; gills composed of lamellæ, five to eight pairs; abdomen long, the sides produced downwards.

FAMILY CRANGONIDÆ.

Mandibles slender, incurved, cutting edge narrow, not dilate or bifid, without a palpus, first and second pairs of feet unequal.

Sub-Family Crangoninæ.

First pair of feet stouter than the second. Hand sub-chelate, the dactylus closing on the margin of the palm, the pollex being spiniform. External maxillipeds pediform.

o Genus CRANGON Fabr.¹ Rostrum very short, eyes free, antennulæ biflagellate, first pair of pereopoda stout, but little longer than the second, second pair slender, elongate, chelate, remaining pairs acuminate. Branchiæ five on each side. Type *Crangon vulgaris* Fabr.

Crangon vulgaris Fabr. Several specimens were collected at Northampton Co., Va.

¹ Including *Steiracrangon* Kinahan, Proc. Royal Irish Acad., viii. p. 68 (1862).

o Genus *PONTOPHILUS* Leach, Sars.¹ Rostrum short, eyes free; antennulæ biflagellate; first pair of pereiopoda stout, second pair very short, slender, chelate. Branchiæ seven, including a rudimentary one on the second maxillipeds. Type *Pontophilus spinosus* Leach.

o Genus *SABINEA* Owen.² Rostrum very short, eyes free, stout; second pair of pereiopoda very short, not chelate, dactylus minute. Branchiæ as in *Pontophilus*.

o Genus *NECTOCRANGON* Brandt.³ Rostrum wanting; eyes nearly hidden by the carapax; second pair of pereiopoda chelate; dactyli of fourth and fifth pairs dilated, natatorial. Branchiæ five on each side, none on the second maxilliped. Type *Nectocrangon lar* (Owen sp.).

o Genus *PARACRANGON* Dana.⁴ Rostrum elongate, eyes free; second pair of pereiopoda obsolete, fourth and fifth pairs acuminate gressorial. Type *Paracrangon echinatus* Dana.

Sub-Family *Lysmatinæ*.

First pair of pereiopoda stouter than the second, both pairs chelate, fingers subequal, carpus of the second pair annulate. External maxillipeds pediform.

o Genus *NIKA* Risso.⁵ Rostrum short, antennulæ biflagellate. Hands of first pair of pereiopoda dissimilar, one being chelate, the other not; carpus of second pair elongate, multiarticulate; hand minutely chelate. Type *Nika edulis* Risso.

o Genus *LYSMATA* Risso.⁶ Rostrum elongate, sub-ensiform, dentate; antennulæ triflagellate; first pair of pereiopoda stout, of medium length, chelate; second pair elongate, carpus multiarticulate; hand rudimentary. Type *Lysmata seticauda* Risso.

o Genus *HIPPOLYSMATA* Stm.⁷ Rostrum elongate, antennulæ biflagellate. External maxilliped elongate, furnished with exog-

¹ Forhandlingar i Videnskabs Selskabet i Christiania, 1861, f. 183. Including *Ægeon* Risso.

² Appendix to the voyage of Captain Ross, p. 82 (1835).

³ *Argis* Kroyer Naturhistorisk Tidsskrift. iv. p. 267 (1842-3) (nom. præoc.). *Nectocrangon* Brandt, in Middendorff's Reise in den Ausserten Norden und Osten Sibiriens, Band II. Zoologie, Theil I. p. 114 (1851).

⁴ U. S. Exploring Expedition, Crustacea, p. 537.

⁵ *Processa* Leach.

⁶ *Meliceria* Risso.

⁷ Proc. Phila. Acad., 1860, p. 26.

nath; first four pairs of feet with exopodite; first pair rather stout, chelate, second filiform chelate, carpus multiarticulate. Type *Hippolysmata vittata* Stm.

Hippolysmata wurdemanni (Gibbes, sp.) Stm. Professor Webster collected a large number of this species at Sarasota and Florida Bays, Fla. There also occur in the collection some young specimens from Bird Shoal, Beaufort, N. C., which I doubtfully refer to this species. I have seen specimens from Fort Jefferson (Lieut. Jacques), and Key West (Packard).

o Genus *TOZEUMA* Stm.¹ Body greatly elongate, slender, compressed; rostrum slender, very long, sometimes scarcely shorter than the body; antennulæ short, biflagellate; external maxillipeds very short, without exognath or flagellum, pereiopoda without palpi; first pair very short, stout, chelate, second filiform, chelate; carpus triarticulate, telson elongate, lanceolate. Type *Tozeuma lanceolatum* Stm.

Tozeuma carolinensis Kingsley (Plate xiv. fig. 8), was collected at Charlotte Harbor, Fla., and Beaufort, N. C.; at the latter place in a surface net.

o Genus *LATREUTES* Stm.² Carapax with a dorsal median spine. Rostrum elongate, lamellate, antennulæ biflagellate, basal scale short, orbiculate, hidden under the eyes; antennal scale acute; external maxillipeds short, with exognath; first four pairs of pereiopoda with palpi, first two pairs chelate, second with the carpus triarticulate. Type *Latreutes ensiferus* (Edw., sp.).

Genus *RHYNCHOCYCLUS* Stm.³ Rostrum large, lamellate, obiculate, antennulæ biflagellate, peduncle short; external maxillipeds short, with exognath; first four pairs of pereiopoda palpigerous; first two chelate, second with the carpus triarticulate. Type *Rhynchocyclus planirostris* (De Haan, sp.).

o Genus *CONCORDIA*,⁴ nov. Dorsum of carapax strongly protuberant; rostrum very short, eyes free; antennulæ with two very short flagella; antennal scale very small; flagellum moderate; external maxillipeds short, stout; first pair of pereiopoda shorter

¹ Proc. Phila. Acad., 1860, p. 26. *Angasia* White, Sp. Bate Proc. Zool. Soc. London, 1863, p. 498.

² Proc. Phila. Acad., 1860, p. 27.

³ *Cyclorhynchus* De Haan, Fauna Japonica, Crustacea, p. 174 (nom. præoc.) *Rhynchocyclus* Stm., Proc. Phila. Acad., 1860, p. 27.

⁴ Named in honor of Union College, to which the specimens belong.

and stouter than the second pair, which in turn are shorter than the remaining pairs; the carpus two articulate. Type *Concordia gibberosus*, sp. n.

Concordia gibberosus, sp. n. (Plate xiv. fig. 5). Carapax with the dorsum strongly elevated, and armed with five spiniform teeth; the first of which is on the rostrum, the last at about the middle of the carapax; carapax between the teeth ecarinate; rostrum very short, not exceeding the short and stout eyes; antennulæ with two very short flagella, the outer swollen and ciliate; antennal scale extending slightly beyond the peduncle of the antennulæ; flagella short, small, regularly tapering, about twice the length of the carapax. First pair of pereiopoda short, stout; fingers about as long as the palm, second pair longer and more slender; carpus two-jointed, first joint longer than the meros, and about twice as long as the second, remaining feet slender, elongate, the propodal joints with a few spines on the posterior margin; dactyli short, curved, with spines on the concave margin; abdomen strongly bent at the middle; telson narrow, tapering, sides straight, extremity acute.

A female with eggs from Fort Macon was about 8 mm. long.

Sub-Family **Gnathophyllinæ**.

Second pair of pereiopoda larger than the first pair, external maxilliped broad, operculiform.

o Genus **GNATHOPHYLLUM**, Latr. Rostrum short, compressed, antennulæ with two very short flagella, carpus of the second pair of pereiopoda not annulate.

FAMILY **ATYIDÆ**.

Mandibles stout, not palpigerous, crown broad, dilated, slightly divided. Second pair of maxillipeds short and broad; first two pairs of pereiopoda nearly equal, the carpus of the second not annulated.

Sub-Family **Atyinæ**.

Pereiopoda without exopodite.

o Genus **ATYA** Leach Rostrum short, depressed; antennulæ biflagellata; external maxillipeds small, slender; first two pairs of pereiopoda similar, carpus lunate, bearding the propodus on the

lower portion, fingers with long pencils of hairs; third, fourth, and fifth pairs much larger and stouter. Type *Atya scabra* Leach.

o Genus *EVATYA* Smith.¹ Rostrum prominent, carinate, with spines above, anterior portion of carapax with scattered spines and spiny carinations. Third pair of pereopoda very stout and tuberculate, basis and coxa anchylosed, ischium and meros firmly united, propodus much shorter than carpus, dactylus very short, unguiform. Type *Evatya crassa* Smith.

o Genus *ATYOIDA* Randall.² Rostrum, antennæ, antennulæ, and the two anterior pairs of pereopoda as in *Atya*; third pair of pereopoda elongate, scarcely stronger than the two anterior pairs.

Known species:—

Type *A. bisulcata* Randall. 1. c. p. 140. *Sandwich Islands*.

A. tahitensis Stm. Proc. Phila. Acad., 1860, p. 28. *Society Islands*.

A. mexicana Stm. Am. Journ. Sci. and Arts, II., xxvii. p. 446.

Caradina mexicana Saussure, op. cit., p. 45, pl. iv. f. 26, *Mexico*.

A. poeyi Guerin, in Raman de Sagra Hist. Cuba, *Cuba*.

A. glabra Kingsley. Proc. Phila. Acad., 1878, p. 93, *West Coast Nicaragua*.

o Genus *CARADINA* M. Edw. Rostrum moderate, antennulæ bi-flagellate; second pair of pereopoda longer than first, fingers of both pairs with pencils of hairs, carpus of first pair very short, excavate in front, of second pair oblong, subcylindrical. Type *Caradina typus* M. Edw.

Genus *ATYEPHYRA* Brito Capello.³ Rostrum many toothed, carapax with supraorbital and antennal spines; hands hairy, and resembling those of *Atya*; eyes well developed.³ Type *A. rosiana*.

Genus *TROGLOCARIS* Dormitzer.⁴ Rostrum thin, with fine teeth on the borders; supraorbital and antennal spines present; eyes rudimentary, pereopoda much as in *Caradina*. Type *Troglocaris schmidtii* Dorm.

¹ Second and third Reports Peabody Academy of Science, p. 95 (1871).

² Journ. Phila. Acad., viii. p. 140 (1839). According to E. von Martens (Archiv für Naturgeschichte, xxxiv. pl. i. p. 47, 1868), this is not a valid genus, as the young of *Atya* have the third pair of pereopoda as in *Atyoida*.

³ Discr. esp. nov. de Crustaceos de Portugal, p. 5, 1866.

⁴ Lotos, III. p. 85 (1853).

Sub-Family **Ephyrinæ.**

Pereiopoda with an exopodite.

Genus **MIERSIA** Kingsley.¹ Rostrum toothed, antennulæ biflagellate, two anterior pairs of pereiopoda, chelate small; the carpus of the second pair not annulate; the three posterior pairs slender. Type *Miersia pelagica* (Risso sp.).

The known species are:—

pelagica (Risso sp.). *Mediterranean.*

punctulata (Risso sp.). *Mediterranean.*

compressa (De Haan sp.). *Japan.*

FAMILY **PALÆMONIDÆ.**

Mandibles stout, incurved, deeply bipartite, apical process narrow, oblong.

Sub-Family **Alpheinæ.**

First pair of feet the larger, chelate; second slender, filiform, generally chelate, carpus frequently annulate.

Section I. MANDIBLES WITH A PALPUS.

o Genus **ALPHEUS** Fabr.² Rostrum very short or wanting, antennulæ biflagellate, eyes hidden under the carapax; mandibles with a two-jointed palpus; external maxillipeds slender, moderate; first pair of pereiopoda generally greatly differing in size; carpus of second pair annulate. Type *Alpheus rapax* Fabricius.

Alpheus minus Say. Numerous specimens were collected. The localities are Beaufort, N. C., Key West, Harbor Key, Sarasota, and Florida Bays, and Marcou Pass. Three specimens from Harbor Key were the largest that I have ever seen, measuring respectively 40.3 mm., 40.8 mm., and 42.3 mm. in length. Among those collected at Key West were several of the form described by Gibbes as *A. formosus*, and two which approached *A. floridanus* in size, form of front, and hand.

Alpheus websteri, sp. n. Carapax slender, compressed, rostrum acute, separated from the orbital hoods by deep sulci. Orbital hoods acute, but not spinose. Penult joint of antennular peduncle

¹ *Ephyra* Roux, Edwards, De Haan, Dana, Heller (nom. præoc.).

² Including *Betulus* Dana. Vide Kingsley, Bulletin U. S. Geol. and Geog. Survey, iv. p. 189, 1878.

about twice as long as the last joint. Antennal scale narrow, regularly tapering, lamellar portion not extending to the spine terminating the external margin. External maxillipeds elongate, extending beyond the antennal peduncle, the last joint with a long pencil of hairs. Larger hand inflated, the upper outer proximal portion circumscribed by an impressed line, a slight constriction of the margins near the articulation of the dactylus; thumb short, with a shallow groove on the outer surface, which extends a short distance on the palmar portion. Dactylus contorted, extending beyond the thumb, extremity rounded. The dactylus and distal portions of the propodus punctate and setose, especially on the inner surface. Smaller hand subcylindrical, fingers about as long as palm, gaping, tips acute, margins fringed. Carpus of second pair five-jointed, first joint three times, and second twice as long as the third or fourth, which are subequal and slightly shorter than the fifth. The telson regularly tapering, the extremity sinuate-truncate. The exopodite of the sixth pair of pleopoda (abdominal feet) bears on the external distal angle of the penultimate joint, an articulated conical black spine, the color persisting in alcohol, and which will readily separate this from any species with which I am acquainted. Its affinities are with *A. sulcatus* of Panama and Peru.

Three specimens from Key West, the largest 25 mm. in length.

Alpheus heterochelis Say. Specimens were collected at Sarasota Bay, Charlotte Harbor, Marcou Pass, Harbor Key, and at Northampton County, Virginia, Eastern Shore, Atlantic side; this last being the farthest north from which the species has been reported.

Alpheus packardii, sp. n. Front, antennulæ and antennæ as in *A. heterochelis* except that the sulci between the base of the rostrum, and the ocular hoods are deeper, and last joint of antennular peduncle longer than in that species. External maxillipeds short, not reaching to the tip of antennal scale. Chelipeds unequal, meros with an acute tooth on the upper distal angle; larger hand strongly compressed, with a sharp tooth above near the articulation of the dactylus, beyond this the hand becomes narrower by means of a sharp bend of the inferior margin, dactylus contorted, and working at an angle of about 30° with the plane of the hand. Smaller hand more slender, but similarly ornamented and armed, the dactylus, however, being spatulate, working vertically, and with its margins and those of the opposing thumb densely fringed with hairs. Car-

pus of the second pair with the first two joints equal, and each as long as the third and fourth together, which, in turn, are subequal, and each slightly shorter than the fifth joint. This species, in a systematic arrangement of the North American forms, would stand between *A. heterochelis* and *A. transversodactylus*, but more nearly to the former. The differences from that species are not easy to describe, but are well marked in the specimens.

I have dedicated this species to my friend and former instructor, Dr. Alpheus S. Packard, Jr., not only as a token of esteem, but also from a recognition of the appropriateness of the name. Three males from Key West. Length, 22 mm.

Alpheus candei Guérin in de Sagra's *Historia de Cuba Crustaceis* (p. L. pl. ii. f. 9). *Alpheus transversodactylus* Kingsley. Two specimens were taken at Key West.

Bes des these species of *Alpheus* there is a single specimen approaching *A. candei* most nearly in form, but differing from that species in form of front, and in having a large swollen pyriform hand without grooves, etc., which I hesitate to describe as new.

o Genus *ALOPE* White.¹ Rostrum short, toothed above, and placed in a groove formed by two spines which arise at the anterior portion of the carapax, and extend nearly as far as the rostrum. Eyes but little salient, antennulæ biflagellate; external maxilliped very long; hands of first pair of pereopoda equal; carpus of second pair annulate. Type *Alope palpalis* White.

Genus *ARETE* Stimpson.² Rostrum short, rounded above; eyes free, antennulæ biflagellate; antennal scales larger. External maxillipeds slender, moderate; hands of first pair of pereopoda large, equal, inversely depressed; dactyli external; second pair short; carpus 4-articulate. Type *Arete dorsalis* Stm.

o Genus *ATHANAS* Leach. Rostrum short; antennulæ triflagellate; eyes but little salient; external maxillipeds short, slender. First pair of pereopoda long, stout, unequal; second filiform; carpus 5-articulate.

o Genus *HIPPOLYTE* Leach.³ Rostrum moderate, more or less

¹ *Annals and Magazine of Natural History*, second series, vol. i. p. 225, 1848.

² *Proc. Acad. Nat. Sci. Philadelphia*, 1860, p. 32.

³ *Bellidia* Gosse. *Annals and Magazine of Natural History*, 4th series, vol. xx. p. 313 (1877). I have not seen Costa's description of *Periclemenes* (*Annal. del Accad. degli Aspiraz. Natur di Napoli* II. p. 285, 1844). Erichson

ensiform, not articulated to the carapax; antennulæ biflagellate; external maxillipeds slender; first pair of feet short, equal; second pair slender; carpus multiarticulate. Type *Hippolyte spinus* (Sowerby sp.).

Genus *CARIDION* Göes.¹ Rostrum elongate, cultrate; mandibles with a three-jointed palpus: antennulæ biflagellate; first two pairs pereopoda nearly equal, chelate, carpus of the first pair very short; of the second elongate, obsoletely biarticulate. Type *Caridion gordonii* (Spence Bate sp.).

Genus *BYTHOCARIS* G. O. Sars.² Rostrum very small, simple, unarmed; antennulæ biflagellate; antennal scale large and broad; external maxilliped with the last joint dilated, obliquely truncate, and armed with teeth, a minute exognath present. First pair of feet as in *Hippolyte*; second pair slender, weak; carpus multiarticulate. Type *Bythocaris simplicirostris* G. O. Sars.

Genus *CRYPTOCHELES* G. O. Sars.³ Rostrum small, narrow, toothed above; antennulæ biflagellate; antennal scale large, externally dentate; last joint of external maxillipeds with the apex somewhat bipartite, a small exognath present. First pair of pereopoda very short; hand very elongate and attenuate, digits very short, and with difficulty visible; second pair slender; carpus 7-jointed. Type *Cryptocheles pygmxæ* G. O. Sars.

o Genus *RHYNCHOCINETES* M. Edw. Resembling *Hippolyte*. Rostrum ensiform, movable, articulated to the carapax; antennulæ biflagellate; carpus of second pair of pereopoda not jointed. Type *Rhynchocinetes typus* M. Edw.

o Genus *OGYRIS* Stm.⁴ Carapax not rostrate, or with rostrum very small, as in the genus *Alpheus*. Eyes very long; antennulæ

in the Archiv für Naturgeschichte, 1846, pt. 2, p. 310-311, says that there are no points mentioned by Costa which would not apply to *Hippolyte*. On the other hand Heller (Crustaceen des südlichen Europa, p. 256, 1863) regards one of Da Costa's species (*P. elegans*) as belonging to the genus *Anchistia* of Dana. For remarks on the synonymy of *Hippolyte* and that of *Virbius*, attention is called to Smith, Trans. Conn. Acad. v. pp. 62 and 63, 1879.

¹ Eftversigt af K. Vetensk. Akad. Förhandl. 1863, p. 170. *Doryphorus* Norman, Ann. et Mag. Nat. Hist. 3d series, viii. p. 276, 1861 (nom. præoc.).

² G. O. Sars, Saerskilt aftrykt af Vidensk. Selsk. Forhandlingar, p. 5, 1869.

³ Vidensk. Selsk. Forhandlingar, p. 150, 1868.

⁴ Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 36.

biflagellate, the peduncle with a spine externally on the basal joint; antennal scale shorter than antennal peduncle; mandible with a two-jointed palpus; external maxilliped long, with a slender exognath; pereiopoda without epipodites; carpus of the second pair triarticulate. Type *Ogyris orientalis* Stm.

Ogyris alphærostris, sp. n. (Plate xiv. fig. 7.) Carapax smooth, without dorsal carina; rostrum very small, triangular, reminding one of that of *Alpheus*. Eyes resembling those of *Hippa*, elongate, slender, half as long as the carapax, and extending slightly beyond the antennal peduncles, the cornea but slightly larger than the ocular peduncle. Antennulæ with a spine on the outer surface of the basal joint; biflagellate, flagella equal, and about as long as the peduncle. Antennæ with the basal scale narrow, lanceolate, reaching nearly to the tip of the penult joint of the peduncle; flagella three times as long as the peduncle, or one and one-half times the length of the carapax. External mallipeds long, stout, the distal joint being very small, and furnished with long hairs, exopodite slender. First pair of pereiopoda slender, chelate; meros, carpus, and hand nearly equal, fingers slightly longer than the palm. Second pair very long, slender, chelate; carpus triarticulate, hand similar to that of first pair. Third and fourth pairs subequal, slender; the dactyli slender and narrow, being not over one-third the width of the preceding joints. Fifth pair very slender, more so than any of the preceding with the ischium longer than the meros, which in turn is about as long as the three last joints; carpus, propodus, and dactylus subequal. The three last pairs of pereiopoda have long hairs on the distal joints. Abdomen smooth, rounded above; telson short, with the sides arcuate, and the tip rounded.

Union College, No. 407, Northampton Co., Va., Eastern shore, Atlantic side. H. E. Webster.

Length 19.5 mm.

Having but a single specimen, and that in poor condition, I have not been able to study it as thoroughly as I could wish. It agrees, as far as I have been able to examine it, with Stimpson's diagnosis of the genus except in the following particulars. The carapax is not cristate, and has a minute rostrum; the antennal flagella are much longer than in the type species; the mandibles, as the specimen is unique, I have not been able to examine. It is the second species of the genus known, and is interesting on ac-

count of its habitat; the other species, *O. orientalis* Stm., coming from China and Japan.

Genus *PTEROCARIS* Heller.¹ Carapax and abdominal segments broadly expanded at the sides. These expansions lamellate and three-lobed, corresponding one to the antennal segments, one to the mandibular, and the third to the abdominal segments. Eyes small, just visible in front of carapax; antennulæ biflagellate; antennæ with basal scale; external maxillipeds with exopodite and rudimentary epipodite. Type *P. typica* Heller.

Section II. MANDIBLES WITHOUT A PALPUS.

Genus *AUTONOMEA* Risso.² Rostrum short, eyes prominent, antennulæ biflagellate, antennal scale wanting. First pair of pereopoda stout, chelate; second not chelate; carpus not annulate. Type *Autonomea olivii*.

o Genus *VIRBIUS* Stimpson.³ Dorsum of carapax and rostrum ecarinate; antennulæ biflagellate; antennal scale present. External maxillipeds short, with exopodite. Pereiopoda without epipodites. Carpus of first pair of pereiopoda excavate in front; carpus of the second pair triarticulate. Type *Virbius acuminatus* (Dana sp.).

o Sub-genus *THOR* Kingsley.⁴ Rostrum short; antennulæ, antennæ, and external mallipeds as in *Virbius*. Carpus of first pair of pereiopoda not excavate; carpus of second pair 5-articulate. Type *Thor floridanus* Kingsley.

Thor floridanus Kingsley. (Pl. xiv. fig. 6.) Specimens were collected by Professor H. E. Webster at Harbor Key and Sarasota Bay, Florida.

¹ Sitzungsberichte der k. Akad. Wissenschaft. Wien. XLV. pt. i. p. 395, pl. i. f. 7-18 (1862).

² I take the fact that the mandible of *Autonomea* is without a palpus from Heller (Crust. Südlichen Europa, p. 223), though in his generic diagnosis on p. 249 he makes no mention of the mandible, but takes his description from Desmarest. Heller had never seen specimens of this genus. Risso (Crust. Nice, pp. 166-169, 1816) does not mention the mandibles.

³ Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 35. For remarks on this genus, vid. Smith, Trans. Conn. Acad. v. p. 62, 1879. *Caradina tenuirostris* Spence Bate, Proc. Zool. Soc'y, London, 1863, p. 501, pl. xl. f. 4, from Australia, belongs to this genus.

⁴ Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 94.

Sub-Family **Pandalinæ**.

Antennulæ biflagellate, mandibles with a palpus, anterior pereopoda very slender, not chelate; second filiform chelate; carpus multiarticulate.

o Genus **PANDALUS** Leach.¹ Type *Pandalus montagui* Leach.

Sub Family **Palæmoninæ**.

Two anterior pairs of pereopoda chelate; carpus of none annulate; second pair larger than the first, pereopoda without palpi.

Section I. MANDIBLES WITHOUT A PALPUS.

A. Antennulæ biflagellate.

Genus **TYPTON** Costa.² Rostrum small, eyes free, antennal scale absent, external maxillipeds pediform, with exognath. Type *Typton spongiola* Costa.

o Genus **PONTONIA** Latreille. Rostrum short, eyes prominent, antennulæ with the outer flagellum bifid at the extremity; antennal scale moderate. External maxillipeds suboperculiform with exognath; second joint broad, longer than remaining joints together, these last cylindrical. Type *Pontonia custos* (Forsk. sp.). Guérin. *Pontonia tyrrhena* (Risso sp.) Latreille.

Pontonia unidens, sp. n. (Pl. xiv. f. 9.) Carapax pubescent, depressed; rostrum short, acute, slightly depressed, not extending as far forward as the eyes; orbital spine present though small; cervical suture well marked; eyes stout, reaching the last joint of the antennular peduncle. Antennulæ with the joints of the peduncle sub-equal; the flagella very short, not as long as the peduncle. Antennal scale about twice as long as broad, extremity rounded and reaching to the last joint of antennular pe-

¹ *Pontophilus* Risso, Hist. Nat. Europe Merid. t. v. p. 63, 1826; Brandt in Middendorff's Reise in den Aussersten Norden und Osten Sibiriens, Bd. ii. Theil i. p. 122, 1851.

² Annali dell' Acad. Segli Aspir. Natur di Napoli ii. 1844 (Teste Heller). *Pontonella* Heller, Verhandlungen des Zool. Bot. Verein in Wien, 1856, p. 624. Rev. A. M. Norman (Ann. and Mag. Nat. Hist. IV. ii. p. 176, 1868) compares this genus with *Alpheus*. It is far more nearly related to *Pontonia*. Its resemblance to *Antonomea*, in the absence of the antennal scale, was noticed by Heller.

duncle. First pair of pereiopoda slender, longer than the carapax; meros, carpus, and hand nearly equal, the fingers half as long as the palm. Second pair of feet unequal; larger hand inflated, longer than the carapax, pubescent; fingers one-third the length of the palm, incurved and slightly depressed; the dactylus with a large obtuse tooth near the base, which fits into a corresponding cavity in the pollex (as in many species of *Alpheus*); pollex without teeth. Smaller hand three-fourths as long as the larger, cylindrical straight fingers one-third as long as the palm. Remaining pereiopoda moderate, minutely unguiculate. Telson about twice as long as broad, sides strongly arcuate.

Key West, Fla., A. S. Packard, Jr.

Length 10 mm.

This species differs from *P. domestica* Gibbes in the pubescence of the carapax and hands, and in having but one tooth on the dactylus of the larger hand of the second pair and none on the thumb, etc. etc. It may prove to be the *Pontonia mexicana* of Guérin-Meneville in Ramen de la Sagra's Historia física, política y natural de la Isla de Cuba, 1856. The types are in the Museum of the Peabody Academy of Science at Salem, Mass. None were collected by Prof. Webster.

Genus CORALLIOCARIS Stm.¹ Rostrum small; eyes large and prominent; antennal scale very broad; external maxillipeds operculiform; all the joints of nearly equal width; second pair of pereiopoda large, long, subequal; dactyli of posterior pairs with a protuberance on the under side near the base. Type *Coralliocaris superbus* Dana, sp.

Genus HARPILIUS Dana.² Closely allied to *Pontonia*, but differing in having the distal joints of the external maxillipeds together longer than the second joint; second pair of pereiopoda long, slender, equal. Type *Harpilius lutescens* Dana.

o Genus ANCHISTIA Dana.³ Rostrum long, slender, frequently ensiform; eyes prominent; antennulæ with one flagellum partly bifid; external maxillipeds slender, pediform; second pair of pe-

¹ Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 38. *Ædipus* Dana, U. S. Ex. Ex. Crust., p. 572, 1851 (nom. præoc.).

² Op. cit., p. 574, 1851.

³ Op. cit., p. 577 (1851), *Pelias* Roux, Memoire sur le Salicoques, p. 25 (1831). Heller, Sitzungsber. der K. Akad. Wiss. Wien, xlv. pt. 1, p. 406 (1862), non Merrian (1820).

reiopoda slender, long, equal; dactyli of posterior pairs long, slender, nearly straight. Type *Anchistia gracilis* Dana.

B. Antennulæ triflagellate.

Genus EURYHYNCHUS Miers.¹ "Rostrum triangular, broad at base, acute, very short, barely reaching the extremity of the eyes; anterior margin of carapax with a small spine between the eyes and the rostrum and another below the point of insertion of the peduncle of the antennæ; antennæ with a small basal scale; antennulæ triflagellate; outer maxillipeds slender, second pair of legs nearly as in *Anchistia*; tarsi of last three pairs of legs nearly straight, acute." Type *E. wrzesnowski* Miers.

I am uncertain as to the exact position of this genus, as the author says nothing concerning the mandibles. There also exist several discrepancies between the description and figures (Plate lxvii. f. 2-2 a). The spine on the anterior margin being represented as external to the eyes, and the first pair of feet being the larger, which, if true, would remove it to the *Alpheinæ*, from all genera of which, however, it is separated by the triflagellate antennulæ. Miers compares it with *Anchistia* and *Harpilius*, and in that locality I allow it to remain.

Genus PALÆMONETES Heller.² Antennæ, antennulæ, and pereopoda as in *Palæmon*; carapax with antennal and branchiostegal spines, hepatic spine wanting; rostrum long, lamellate. Type *Palæmonetes varians* (Leach, sp.).

Palæmonetes carolinus Stm. Specimens were collected by Prof. Webster at Beaufort, N. C., and Marcou Pass, Fla.

Palæmonetes vulgaris (Say, sp.), Stm. Beaufort, N. C., Northampton Co., Va., and Charlotte Harbor, Fla.

o Genus UROCARIS Stm.³ Body slender, compressed; rostrum cristate and toothed above, beneath straight, and edentulous; ocular peduncles long; abdomen slender, elongate, the sixth segment very much so. Type *Urocaris longicaudata* Stm.

Urocaris longicaudata Stm. (l. c., p. 39.). As Stimpson's description is very short, and as this species has not been noticed by subsequent writers, I append a short description, based upon speci-

¹ Proceedings of the Zoological Society of London, 1877, p. 662.

² Zeitschrift für Wissenschaftliche Zoologie, xix. p. 157.

³ Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 39.

mens collected by Prof. Webster at Beaufort, N. C., Marcou Pass, and Charlotte Harbor, Fla. Only four specimens were obtained, two male and two female.

Rostrum compressed, not reaching the extremity of the antennular peduncles; above arcuate, with seven or eight teeth, the second of which is directly above the insertion of the eyes; antennal scale large, extending beyond the antennular peduncle, the sides parallel, the extremity obliquely rounded, truncate; first pair of pereiopoda reaching the tip of the antennal scale, the second longer, the fingers of each about as long as the palm, remaining feet bi-unguiculate, all very slender and almost filiform; abdomen between four and five times the length of the carapax; third segment (and sometimes the fourth also) of the abdomen swollen, fifth short, sixth about the length of the carapax; telson slender, elongate, sides straight, regularly tapering to the acute tip. The female appears to be rather stouter than the male. Length 15.5-20 mm.

Section II. MANDIBLES WITH A PALPUS.

A. Antennulæ biflagellate.

Genus *PALEMONELLA* Dana.¹ Body not depressed; rostrum moderate; eyes of medium size; mandibular palpus two-jointed, very short; antennulæ biflagellate, one flagellum with the apex bifid; external maxillipeds slender, pediform. Type *Palemonella tenuipes* Dana.

o Genus *HYMENOCERA* Latreille. Antennulæ biflagellate, one flagellum membranous, dilated, and foliaceous; first pair of pereiopoda very slender, hand minute, second stouter, very broad, hand and dactylus membranous.

B. Antennulæ triflagellate.

o Genus *PALÆMON* Fabr.² Rostrum lamellate, dentate; eyes free; mandibles with a three-jointed palpus; external maxillipeds slender. Type *Palæmon squilla* (Linne, sp.).

¹ U. S. Expl. Exped. Crust., p. 582.

² *Leander*, Desmarest, Annales Société Entomologique de France, vii. p. 87, 1849. *Bithynis*, Philippi, Archiv für Naturgeschichte, xxvi. pt. 1, pp. 161-164 (1860). *Macrobrachium*, Spence Bate, Proc. Zool. Soc'y London, 1868, p. 363.

Genus *CRYPHIOPS* Dana.¹ Rostrum of medium size; eyes wholly hidden under the carapax, as in *Alpheus*; external maxillipeds slender. Type *Cryphiops spinulosimanus* Dana.

Sub-Family **Oplophorinæ.**

First pair of pereopoda either didactyle or vergiform, second stouter, chelate; antennulæ biflagellate.

Genus *OPLOPHORUS* M. Edw. Rostrum long, dentate, pereopoda all palpigerous; four anterior chelate; antennal scale with the external margin spined; abdomen armed above with one or more long spiniform processes. Type *Oplophorus typus* M. Edw.

Genus *CAULURUS* Stm.² Rostrum long or short; basal scale of antennulæ wanting; basal scale of antennæ externally unarmed; external maxillipeds pediform, with exognath; pereopoda furnished with exopodite, the first two pairs chelate, the second pair slender and long; dorsum of abdomen unarmed; sixth abdominal segment long and slender. Type *Caulurus pelagicus* Stm.

As there is nothing except the length of the rostrum to separate *Xiphocaris* from *Caulurus*, I have thought best to unite them. *Xiphocaris* has but a single species, *Hippolyte elongata* Guerin = *Oplophorus Americanus* Saussure.

Genus *THALASSIOCARIS* Stm.³ Rostrum and antennulæ as in *Oplophorus*. Feet not palpigerous, anterior pair not chelate; second pair stout, chelate; mandibular palpus triarticulate; third segment of abdomen prolonged into a long spine above. Type *Thalassiocaris lucidus* (Dana, sp.).

FAMILY **PENÆIDÆ.**

Genus *SICYONIA* Edw., Stm.

Sicyonia lævigata Stm. A single specimen of this species was collected at Sarasota Bay, Fla.

Sicyonia carinata M. Edw.

Palaemon carinatus Olivier, Encyclopédie Méthodique, viii. p. 667 (teste Edw.).

¹ Op. cit., p. 594.

² Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 42. *Xiphocaris*, E. von Martens, Archiv für Naturgeschichte, xxxviii. Bd. i. p. 139 (1872).

³ Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 42. *Regulus*, Dana, op. cit., p. 597 (nomen præoccupatum).

Sicyonia carinata M. Edw., Hist. Nat. Crust., ii. p. 410. Dana, U. S. Ex. Ex. Crust., p. 602. Smith, Trans. Conn. Acad., ii. p. 40. Von Martens, Archiv für Naturgesch. xxxviii. p. 142.

Of this species, which is reported from Rio Janeiro by Edwards and Dana, and from Cuba by von Martens, two specimens were collected by Prof. Webster, one at Sarasota Bay and the other at Charlotte Harbor.

Genus *PENEUS* Fabr.

Peneus constrictus Stm. A single specimen was collected at Marcou Pass.

Peneus braziliensis Latreille. From Beaufort, N. C., Marcou Pass, Charlotte Harbor, and Sarasota Bay, Fla. I would here say that the specimens described by me as *Peneus brevirostris* (Proc. Acad. Nat. Sci. Philadelphia, 1878), from the west coast of Nicaragua, prove to be *P. braziliensis*, thus adding another to the list of species common to both coasts.

In my "List of Decapod Crustacea of the Atlantic Coast, whose range embraces Fort Macon" (Proceedings Philadelphia Academy, 1878, pp. 316-330), I enumerated sixty-five species, of which fifty-three had at that time been reported from Fort Macon. In this paper six more of these species are reported from there, while *Polyonyx macrocheles*, *Lepidops venusta*, *Hippolysmata wurdemanni*, and *Concordia gibberosa*, which were not enumerated in my list, were found there by Prof. Webster, and *Ogyris alphærostris*, from its near locality, may reasonably be expected there.

EXPLANATION OF PLATE.

Fig. 1. *Mithraculus hirsutipes*; 1a. Antennal region.

Fig. 2. *Pisosoma glabra*.

Fig. 3. *Eupilumnus websteri*; 3a. External maxilliped.

Fig. 4. *Euceramus prælongus*; 4a. External maxilliped. 4b. Telson.

Fig. 5. *Concordia gibberosa*.

Fig. 6. *Thor floridanus*; 6a. Antennula. 6b. Mandible.

Fig. 7. *Ogyris alphærostris*.

Fig. 8. *Tozeuma carolinensis*.

Fig. 9. *Pontonia unidens*; larger hand outside; 9a. Ditto inside.

DECEMBER 2.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-six persons present.

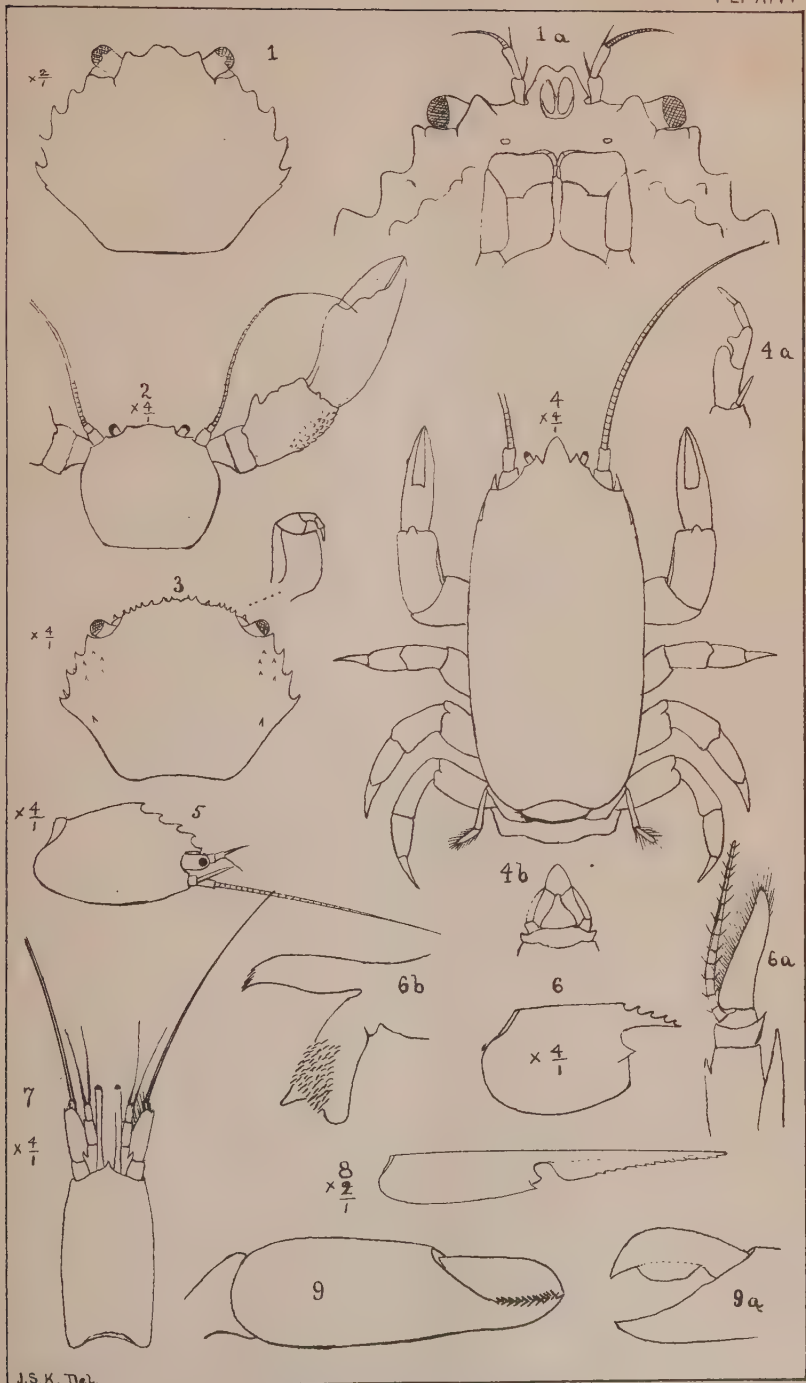
DECEMBER 9.

The President, Dr. RUSCHENBERGER, in the chair.

Fifty persons present.

A paper entitled "Description of a Fœtal Walrus," by Harrison Allen, M.D., was presented for publication.

Complete Connection of the Fissura Centralis (Fiss. of Rolando) with the Fossa Sylvii.—Dr. A. J. PARKER stated that Dr. Chas. K. Mills had lately observed, while examining the brain of a white person, that the central fissure ran completely into the fossa Sylvii without any bridging convolution being found present. The fissura centralis, as it exists in the higher primates, begins at the upper border of the hemisphere, and extends obliquely downwards and forwards, terminating above the Sylvian, so that we find an arched convolution surrounding its lower end and completely separating it from the Sylvian fissure. In 1866, however, Turner reported a case (Edinburgh Medical Journal, 1866) in which he found this fissure joining the Sylvian. This appears to be, up to that time, the only recorded case. Ecker, in speaking of this observation (Cerebral Convolutions of Man, trans. by R. T. Edes, M.D., 1873), says: "I have not yet seen a complete opening of the central furrow into the fissura Sylvii of which Turner speaks;" and Bischoff goes so far as to affirm (Die Grosshirnwindungen des Menschen, etc., Abhand. der k. bair. Akad. der Wissenschaften München, 1868), that the central fissure bends with its upper end gradually backwards, but it remains closed at its upper and lower end, and *never* opens into the fossa Sylvii. In the Proc. of Academy of Nat. Sciences Phila., 1878, Dr. Parker has reported a case similar to those observed by Prof. Turner and Dr. Mills, a photograph of which was exhibited; so that we have now at least three well-authenticated cases in which this relation of the two fissures referred to above existed. Bischoff objects to the observation of Turner on account of its disagreement with certain views in regard to the morphology of the cerebral convolutions which he advances in the paper referred to above. He considers that "a large number of the convolutions of the great hemisphere are arranged around the ends of the primary furrows in more or less simple or



J.S.K. Del.

KINGSLEY ON CRUSTACEA.

CARCINOLOGICAL NOTES No. I.

BY J. S. KINGSLEY.

It is the intention of the writer in this series of notes to give descriptions of new species, rectifications of synonymy, facts relating to geographical distribution, and other matters of importance concerning the Decapoda. Unless otherwise stated all specimens are in the collection of the Academy of Natural Sciences of Philadelphia.

Genus **PSEUDOTHELPHUSA** Saussure.(*Potamia* Latr. et *Boscia* Edw. preoc.)***Pseudothelphusa latifrons*.**

Potamia latifrons Randall, Journal of the Academy of Natural Sciences of Philadelphia, viii. p. 120.

Carapax smooth, regions and sutures indistinct. Frontal crest very prominent, uninterrupted. Front reflexed, making with the surface of carapax an angle of about 45° , its margin undulating and its surface and margin granulate. From the front arise processes which all but join the inferior margin of the orbit. Superior margin of orbit crenulated. Anterolateral teeth more prominent than in any other of the genus and extending back to the posterior third of the carapax. Below, the carapax is everywhere granulate and especially so on the sub-branchial regions and near the mouth. Inferior margins of orbits denticulate. Chelipeds nearly equal. Anterior surface of meros granulate, as are the outer portions of carpus and upper portions of the hands. The dactyli with rows of small tubercles above.

The species is a true *Pseudothelphusa*, the antennæ being as in that genus, but the reflexed front gives it a peculiar appearance and with the larger anterolateral teeth will readily separate it from all other known forms. The emargination of the external margin of the orbit is no more marked than in *P. chilensis* (Edw. and Lucas) Smith, the type of which, by the way, is in the Museum of the Academy.

***Pseudothelphusa sinuatifrons* (A. M.-Edw.) Smith.**

The locality of this species was not known to Alphonse Milne-Edwards. There are two males in the Academy's collection from San Domingo (W. M. Gabb).

Genus **DILOCARCINUS**.

Dilocarcinus pardalinus Gerstæcker, Archiv für Naturgeschichte xxii, p. 148, 1856.

Gerstæcker gives doubtfully South America as the habitat of this species. There are specimens with the label "? Upper Amazon, Dr. Wilson."

Dilocarcinus spinifrons, nov.

Carapax regularly arcuate, regions obsolete, sides arcuate, armed with four spines besides the spiniform angle of the orbit; the margins of the spines finely serrate. Superior margin of the orbit obscurely crenulate, inferior denticulate with a strong spine near the interior angle. Front advanced, with about fourteen spines. A spine at the anterolateral angles of the buccal area. Chelipeds sub-equal, meros with two spines at about the middle of the posterior margin and a single one on the anterior margin at about the middle, and one on the distal portion of the upper margin; the spine on the interior surface of the corpus long, slender, acute. Hand with an acute spine above at the articulation of the dactylus, fingers with the denticulations fine but acute. Ambulatory feet less dilated than is usual in this genus. The spined front readily separates this from all other species.

Upper Amazon, Dr. T. B. Wilson.

Genus **THELPHUSA** (including *Geothelphusa* Stm.)

Of this genus forty-five species have been described. The localities from which I have examined specimens are marked with an exclamation point (!).

<i>africana</i> A. M.-Edw.	West Africa.	<i>corrugata</i> Heller.	Madras, Java.
<i>anchietæ</i> Capello.	West Africa.	<i>crassa</i> A. M.-Edw.	Australia.
<i>andersoniana</i> Wood-Mason.	Burmah.	<i>cristata</i> A. M.-Edw.	East Indies(!).
<i>angustifrons</i> A. M.-Edw.	Australia.	<i>dehaani</i> White.	Japan.
<i>aubryi</i> M.-Edw.		<i>berardi</i> DeHaan.	
	West Coast Africa (!); Natal (!).	<i>japonica</i> Herklots.	
<i>aurantia</i> Herklots.		<i>denticulata</i> M.-Edw.	China.
<i>pelii</i> Herklots.		<i>depressa</i> Krauss.	Port Natal.
<i>atkinsoniana</i> Wood-Mason.		<i>difformis</i> M.-Edw.	Red Sea.
	Northern India.	<i>edwardsii</i> Wood-Mason.	Burmah.
<i>austeniana</i> Wood-Mason.	India.	<i>fluviatilis</i> (Bosc.) Latr.	Mediterranean
<i>bayonica</i> Capello.	West Africa.		Region, Greece (!), Gaarda Sea (!),
<i>bayonica</i> var. α Capello.	West Africa.		(Museum Peabody Academy).
<i>berardi</i> Savigny.		<i>grapsoides</i> White.	Manilla.
	Egypt, Nile (!); Red Sea.	? <i>subquadrata</i> Gerst.	
<i>chilensis</i> (Heller) A. M.-Edw.	Chili.	<i>goudoti</i> M.-Edw.	Madagascar.

<i>guerini</i> M.-Edw.	India.	<i>obesa</i> A. M.-Edw.	Zanzibar.
<i>hispida</i> Wood-Mason.	Burmah,	<i>obtusipes</i> (Stm.) A. M.-Edw.	
<i>hydrodromus</i> Gerst.			Japan, Philippines.
<i>indica</i> Latr.	India.	<i>perlata</i> Edw.	South Africa, Pt. Natal (!).
<i>canicularis</i> Westwood.		<i>philippina</i> von Martens.	Philippines.
? <i>aurantia</i> Gerstæcker.		<i>picta</i> von Martens.	Philippines.
? <i>rotunda</i> Freycinet.		<i>planata</i> A. M.-Edw.	Bombay.
<i>inflata</i> M.-Edw.	Pt. Natal.	= ? <i>guerini</i> M. Edw.	
<i>jagori</i> von Martens.	Philippines.	<i>siamensis</i> A. M.-Edw.	Siam.
<i>lævis</i> Wood-Mason.	India.	<i>sinuatifrons</i> M.-Edw.	Unknown.
<i>larnaudi</i> A. M.-Edw.	Siam.	<i>stoliczkana</i> Wood-Mason.	Penang.
<i>leschenaulti</i> Edw.		<i>subquadrata</i> Gerst.	
	India (!), Mauritius, Tahiti.	= ? <i>grapsoides</i> .	
<i>lugubris</i> Wood-Mason.	India.	<i>transversa</i> von Martens.	Australia.
<i>margaritaria</i> A. M.-Edw.	West Africa.	<i>tumida</i> Wood-Mason.	Burmah.
<i>nilotica</i> M. Edw.	Nile.		

To this list I would add three more :

***Thelphusa emarginata* nov.**

Carapax glabrous, longitudinally strongly arched. Post-frontal crest continuous, nearly straight, obscurely crenulate, epibranchial tooth obsolete, a tooth between the extremity of the post-frontal crest and the angle of the orbit. Protogastric region very short, front about one-fourth the width of carapax, slightly sinuate. External angle of orbit slightly emarginate. Anterolateral margin cristate; crest, however, soon becoming obsolete. Chelipeds sub-equal, meros with the margins tuberculate and with a strong spine on the distal portion. Upper and outer surface of carpus with indistinct squamæ, inner portion two-spined, the proximal spine exhibiting a tendency to become bifid. Hands with the upper margin obsoletely tuberculate, fingers roughened, not gaping. Ambulatory feet slender, compressed.

Is very near *T. depressa* Krauss, but differs from that species in the narrower and straighter front, the tooth just behind the angle of the orbit, and in the non-gaping fingers of the chelipeds.

Length 34 mm., breadth 56 mm.

West Africa, Du Chaillu ; *Port Natal*, Dr. T. B. Wilson.

The name is proposed on account of the emargination of the orbit.

***Thelphusa enodis* nov.**

Carapax smooth; post frontal crest wanting. Epibranchial tooth very small. Front narrow, strongly curved downward, its margin concave. Chelipeds unequal, hands with the inferior

TELMESSUS.

Telmessus, White, Ann. & Mag. Nat. Hist. (ser. 1) xvii. p. 497 (1846).

Platycorystes, Brandt, Bull. Phys. Math. Acad. Pétersb. vii. p. 179 (1849).

Cheiragonus, Stimpson, Boston Journ. Nat. Hist. vi. p. 465 (1857).

The term *Cheiragonus* appears to have been adopted for this genus on insufficient grounds; it is referred to by Latreille, without description, simply as follows:—"g. *Cheiragone* (Mém. de l'Acad. de St. Pétersb. 1812)," (see Fam. Nat. Règne Anim. p. 270, 1825). On referring to Tilesius' specific description in (Mém. Acad. Pétersb. v. p. 347, pl. vii. fig. 1, 1815), we find it headed *Cheiragonus*, the description commencing with the words *Cancer cheiragonus*. It seems evident to me that Tilesius intended the term *Cheiragonus* as a specific name for the Kamtchatkan species, which must be designated *Telmessus cheiragonus*, as White's generic name *Telmessus* comes next in priority and is accompanied by a description.

TELMESSUS ACUTIDENS.

Cheiragonus acutidens, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 40 (1858).

Japan, Kunashir, lat. $43^{\circ} 34' N.$, long. $145^{\circ} 20' E.$, at 11 fathoms, on a bottom of small stones, three specimens, and N.E. of Yedo Island, in lat. $44^{\circ} 27' N.$, long. $14^{\circ} 22' E.$, one specimen.

This species is separated from the *Telmessus serratus* of the western American coast by a very slight character, the somewhat longer and slenderer teeth of the lateral margins, particularly the third tooth; yet the distinction is constant as far as the series before me serves to prove. Two of the specimens are prettily speckled with brownish red, the spots being visible beneath the close pubescence of the carapace. The carapace of the largest of the four specimens only measures $\frac{3}{4}$ inch in length; and the form of the teeth might undergo some modification as the animal increases in size.

It was previously unrepresented in the British-Museum collection.

Tilesius' species, *Telmessus cheiragonus* from Kamtchatka, is described and figured as having much longer and slenderer marginal spines than even *T. acutidens*; and in the absence of specimens for comparison, I cannot unite the two species.

CATOMETOPA vel GRAPSOIDEA.

MACROPHthalmidæ.

GELASIMUS LACTEUS.

Ocypode (Gelasimus) lactea, De Haan, Faun. Japon., Crust. pp. 26, 54, pl. xv. fig. 5 (1835); M.-Edw.?, Ann. Sci. Nat. (sér. 3), Zool. xviii. p. 150, pl. iv. fig. 16 (1852).

Four specimens (males) are in the collection, without any particulars regarding the locality at which they were collected.

CARCINOLOGICAL NOTES, No. II.—REVISION OF THE GELASIMI.

BY J. S. KINGSLEY.

I have endeavored in this paper to straighten out the species of the "Fiddler Crabs," basing my work on the large collections of the Academy of Natural Sciences of Philadelphia and of the Peabody Academy of Sciences at Salem, Mass. My material has been ample, embracing more than half the known forms, among which are types of Smith, Guerin, Eydoux, Leconte and Say, with other specimens from Guerin's collection which were identified by comparison with the types of Milne Edwards. I have reduced considerably the number of specific forms, and in so doing I have been actuated not by any desire to overturn the work of others, but merely to arrive at the true limits of the species. A similar reduction in other genera must be made, and will be made, by any one who attempts to study the forms of the whole world, and does not limit himself to those of a small portion of its surface. Among the important features of this paper is the extension of the range of many forms, which has been accomplished either by finding new localities among the specimens studied, or by a union of two or more so-called species which bore different names in different portions of the world.

I have endeavored to give descriptions and figures of all known forms of Gelasimi, and when possible I have taken them from the specimens themselves; when I had no specimens, I have given a description compiled from some other carcinologist, and have followed it by the initial of his name. The same remark will apply to the figures. Localities from which I have examined specimens are followed by an exclamation point (!), and the museum in which the forms are preserved is indicated by an abbreviation; these abbreviations are: Phila. Acad., Academy of Natural Sciences of Philadelphia, Pa.; Peab. Acad., Peabody Academy of Sciences, Salem, Mass.; U. C., Union College, Schenectady, N. Y.

Genus **GELASIMUS** Latreille.

Cancer (pars.) Linne, Herbst, Fabricius, De Geer. *Ocypoda* (pars) Bosc, Histoire Naturelle des Crustacés, ii, p. 240 (1828)¹; Latreille,

¹ I have never seen a copy of the first edition of this work published in the "An X" of the first French Republic (1802-3 of accepted chronology), and my references are either quoted from the second edition by Desmarest, or at second hand from Milne Edwards, or some other author.

Histoire des Crustacés et de la Insects, vi, p. 27, "An. XI" (1803-4.) *Uca* Leach, Trans. Linn. Soc., London, xi, p. 309 (1815). *Gelasimus* Latreille, Nouvelle Dictionnaire d'Histoire Naturelle, xii, p. 517 (1817); Henri Milne-Edwards, Histoire Naturelle des Crustacés, ii, p. 49 (1837); Annales des Sciences Naturelles, III série, xviii, p. 144 (1852); Dana, Crustacea of the United States Exploring Expedition, pp. 312 and 315 (1852); Hess, Archiv für Naturgeschichte, xxxi, Pt. II, p. 145 (1865); Alphonse Milne-Edwards, Nouvelle Archives du Museum d'Histoire Naturelle, xi, p. 271 (1873); *Gonoplax* (pars.) Lamarck, Histoire Animaux sans Vertèbres, v, p. 253 (1818).

The genus *Gelasimus* belongs to *Cyclometopa* (*Ocypodoidea* of Dana), family *Macrophthalmidæ* (Dana), and sub-family *Ocypodinae* of the same author. It is characterized by the rhomboidal carapax, broader in front, the elongate ocular pedicels, the eyes proper being placed at the extremity, and by the great inequality of the chelipeds in the male.

In my studies I have found the characters derived from the larger cheliped of the male to be the most constant, while the relative proportions of the carapax, the front and the margins of the orbit, are of but slight importance and very variable.

But two species ever referred to this genus by authors, are now referred to other genera; *Gelasimus cordiformis* forming the type of the genus *Helæcius* of Dana, and *Gelasimus telescopicus* Owen, which belongs to the genus *Macrophthalmus*.

The genus may be divided into two groups, possibly of sub-generic value, according as the front between the eyes is wide or narrow, and the wide fronted section again according as the male abdomen is seven or five jointed.

§ A. *Front very narrow between the eyes.*

1. *Gelasimus maracoani* Latreille. Pl. ix, f. 1.

Ocypoda maracoani Latreille, Hist. Crust. et Ins., vi, p. 46 (1803). *Gelasimus maracoani* Latreille, Dict. d'Hist. Nat., xii, p. 519 (1817); Desmarest. Consid. (pars) p. 123 (1825); Edw., Hist. Nat. Crust., ii, p. 51 (1837); Ann. Sci. Nat., III, xviii, p. 144, pl. III, f. 1 (1852); Dana, U. S. Ex. Crust., p. 318 (1852); White, List. Crust. Brit. Mus., p. 35 (1847). *Gonoplax maracoani* Lamarck, Hist. An. Sans Vert., v, p. 254 (1818). *Gelasimus armatus* Smith, Trans. Conn. Acad., ii, p. 123, pl. ii, f. 5, pl. iii, f. 4 (1870); Report Peabody Acad. Sci., iii, p. 91 (1871).

Regions distinct, each branchial ornamented with a longitudinal ridge, from which branch off smaller ones. Ischium of larger

cheliped with a prominent tooth below; meros with a tooth on posterior margin at the articulation with the carpus, otherwise smooth and rounded, its upper and lower margins with spiniform teeth which are more prominent above; carpus elongate, with indistinct tubercles. Hand very large, compressed, externally tuberculate on the basal portion, above with several teeth like those of meros, inferior margin proximally tuberculate, outer surface of thumb with large shallow punctæ, the lower portion being marginate. Occludent margin with three rows of tubercles, the middle one forming a prominence at the basal two-fifths, the other rows undulating, extremity contorted, acute; inner surface nearly smooth, with a tubercular ridge running from the articulation of dactylus to the middle of lower margin of the palm; dactylus lamellate, externally granulate, lower margin nearly straight, upper margin arcuate, basally tuberculate, tip acute and nearly at right angles with occludent margin, inner surface nearly smooth, somewhat concave, with a longitudinal tuberculate ridge near the occludent margin.

Bahia, Brazil! Dr. Wilson. *Natal!* [?] Dr. Wilson (labeled *G. natalensis*). *South America!* (Phila. Acad.) *West Coast of Nicaragua!* McNiel (Smith's types in Peab. Acad.). *Cayenne* (Latr. Edw.), *Brazil* (Latr. White), *West Indies* (White), *Rio Janeiro* (Dana).

The only differences between Smith's types and specimens from other localities, are the more crowded spines on the upper border of the meros and the more sparse tuberculation of the basal portion of the hand, characters surely not of specific importance.

2. *Gelasimus heterocheles* Kingsley. Pl. ix, f. 2.

Seba, Thesaurus, iii, pl. xviii, f. 8 (1758); *Cancer vocans major* Herbst, Naturgesch. Krabben und Krebse, pl. i, f. 1 (after Seba) (1790). *Ocypoda heterocheles* Bosc, Edit. I, "tom. ii, p. 197, 1802" (teste Auct.); Edit. II, i, p. 250 (1828); *Cancer uka* Shaw, Naturalist's Miscellany, XIV, pl. 588 (after Seba).¹ *Gelasimus maracoani* (pars) Desmarest, l. c., p. 123 (1825). *Gelasimus platydactylus* Edw., Hist. Nat. des Crust., ii, p. 51 (1837); Ann. Sci. Nat., III, xviii, p.

¹ I have been unable to ascertain the date of this volume. The first volume of the series bears the date 1790, the twenty-fourth (and last) 1813, but no others are dated; it would, however, seem probable that the fourteenth volume appeared in 1803, while the "An X," in which Bosc's first edition appeared, embraced parts of 1802 and 1803.

144, pl. iii, f. 2 (1852); Saussure, *Revue et Magazin de Zoologie*, II, v, p. 362 (1853); Smith, *Trans. Conn. Acad.*, ii, p. 122 (1870). *Gelasimus princeps* Smith, l. c., p. 120, pl. ii, f. 10, pl. iii, f. 3-3e (1870); Report Peab. Acad., iii, p. 91 (1871); Lockington, *Proc. California Acad.*, vii, p. 145 (1877).

Carapax transversely nearly flat; meros of larger cheliped rounded posteriorly, its lower margin crenulate, its upper produced into a broad, arcuate, laminiform, dentate crest; carpus elongate, externally tuberculate, inner margin crenulate, the inner surface with one or two tubercles. Hand large, compressed, palmar portion swollen, upper and lower margins tuberculate, external surface of palm tuberculate, of thumb smooth, except a crenulated ridge below. The inner surface smooth, with a tuberculate ridge running from the lower margin at the base of the thumb obliquely upward and backward, and meeting a similar ridge from the base of the dactylus; occludent margins of thumb with three rows of tubercles, (the middle the most prominent) and somewhat angulated beyond the middle. Dactylus with the upper margin and outer basal portion tuberculate, the occludent margin rather prominent in the middle.

Mexico! (Guerin-Meneville). *Jamaica!* (Dr. Wilson) *Phila. Acad. Cayenne*, Edw. *W. Coast Nicaragua!* (McNiel, Smith's types Peab. Acad.). *Lower California* (Lockington). *Muzatlan* (Saussure).

Seba's figure represents the carapax as granulate and the front rather broad (in these respects he has been followed by Herbst and Shaw), otherwise his figure answers well. Bosc says that the species is black! Smith's types agree well with the Jamaica specimens which I have seen, except that the meral crest in the Nicaraguan specimens is more distinctly dentate.

3. *Gelasimus bellator* White. Pl. ix, f. 3.

Petiver, *Opera*, i, Pl. 78, f. 5 (1767); *Gelasimus bellator* White, *Catalogue British Museum Crustacea*, p. 36 (1847); (sine descr.) *Voyage of H. M. S. Samarang, Crustacea*, p. 49 (1848); Edw., *Ann. Sci. Nat.*, III, xviii, p. 146 (1852).

Carapax arcuate, front but little enlarged below the eyes. Meros of larger cheliped posteriorly with an oblique rounded ridge, its upper and lower margins crenulate, the former even denticulate; carpus externally polished, above granulate, inner margin denticulate, outside of palm and basal portion of dactylus granulate, inside of palm granulate but without tubercular ridges

except a short curved one near the occludent margin; thumb externally margined below, its occludent margin forming a prominence at the distal third; dactylus with the margins nearly parallel, the occludent one with scattered larger tubercles, tip acute.

Australia! (Dr. T. B. Wilson) Phila. Acad. *Luzon* (Petiver) *Philippines* (White).

4. *Gelasimus styliferus*, Edw. Pl. ix, f. 4.

Gelasimus platydactylus Edw., Ill. Edit. Regne Animal, Crustaces, pl. xviii, f. 1 a (without date). *Gelasimus styliferus* Edw., Am. Sci. Nat. III, xviii, p. 145, pl. iii, f. 3, (1852); Smith, Trans. Conn. Acad., ii, p. 118, (1870).

A species very near *G. platydactylus*, but having the marginal crest of the arm less developed and the eye stalks terminated by a small stylet as in the *Ocypodas* (Edw.). Is possibly but a variety of *heterocheles*.

Guayaquil, Ecuador, (Edw.).

5. *Gelasimus heterophthalmus* Smith. Pl. ix, f. 5.

Gelasimus heterophthalmus Smith, Trans. Conn. Acad. ii, p. 116, pl. ii, f. 6, pl. iii, f. 1 (1870); Rep. Peab. Acad. Sci. iii, p. 91 (1871).

Meros of larger cheliped with posterior margin rounded, the inferior crenulate, superior with a broad crest, carpus with the upper outer surface granulate, elsewhere smooth. Hand inflated. basal portion of palm externally granulate, thumb punctate, with an external elevated ridge. Inner surface of palm smooth, with two rows of tubercles much as in *G. heterocheles*. Fingers compressed, the thumb with a deep emargination at the base and a prominent tubercle just beyond, occludent margin of finger nearly straight.

Gulf of Fonseca, West Coast of Nicaragua! McNiel (Smith's types in Peab. Acad.).

This species is closely allied to *G. heterocheles*. When I examined the specimens, the prolongations of the ocular peduncles described by Prof. Smith were broken off.

6. *Gelasimus heteropleurus* Smith. Pl. ix, f. 6.

Gelasimus heteropleurus Smith, Trans. Conn. Acad., ii, p. 118, pl. ii, f. 7, pl. iii, f. 2 (1870); Rep. Peab. Acad., iii, p. 71 (1871).

Carapax but slightly convex, one side produced laterally. One eye with a stylet about as long as the cornea, similar to those found in certain *Ocypodæ*. Meros of larger cheliped with the

margins denticulate, the upper one produced distally into a crest, carpus granulate above. Hand externally granulate on the basal portion, the upper and lower margins denticulate; the inner surface of the palm has an oblique line of tubercles running obliquely upward and backward from the lower margin at the base of the thumb to near the articulation with the carpus. Fingers short, compressed, the thumb with the lower margin regularly arcuate; the upper margin of dactylus nearly straight as are the occludent margins of each.

Gulf of Fonseca! McNeil (Peab. Acad., Smith's types).

7. *Gelasimus cultrimanus* White. Pl. ix, f. 7.

Gelasimus vocans Edw., Annales des Sci. Nat., III, xviii, p. 145, Pl. III, f. 4 (1852); Stimpson, Proc. Phila. Acad., 1858, p. 99 (1858); Heller, Reise der Novara, Crustacea, p. 37 (1865); Hilgendorf, in van der Decken's Reise, p. 83 (1867); Alphonse Milne-Edwards, Nouv. Arch. du Mus. d'Hist. Nat., ix, p. 272 (1873). *Gelasimus cultrimanus* White, Catalogue Brit. Mus. Crust., p. 35, sine descr. (1847); Voyage of the Samarang, Crust., p. 49 (1848). *Gelasimus nitidus* Dana, U. S. Expl. Exped. Crust, p. 316, Pl. X, f. 5 (1852).

Carapax smooth, arcuate. Meros of larger cheliped with an oblique ridge on the upper posterior surface which gradually disappears before the articulation with the carpus; the inner margin somewhat cristate, distally with a prominent tooth and sometimes traces of a second; carpus externally granulate, a portion near the articulation with the meros smooth, inner surface with a strong spiniform tubercle. Palmar portion of hand swollen and externally granulate, granules larger below. On the inner surface there is an oblique tubercular crest near the lower margin but not extending to it, and a second near the occludent margin. Thumb with an impressed line on the outer surface, the lower margin granulous, the occludent margin broadly excavate; this excavation is sometimes regularly curved, but generally shows traces of a division into two sinuses; the distal fourth bends abruptly downward to meet the inferior margin. Finger granulate above near the base, occludent margin nearly straight.

Philippines? Dr. T. B. Wilson (Phila. Acad.); *Moreton Bay, Australia!* E. Wilson (Phila. Acad.); *Coast of Malabar!* Guerin's Collection (Phila. Acad.). This specimen (labelled "*G. crassimanus* Coll. Mus.") has the excavation of the thumb of the larger cheliped plainly divided into two parts. *Java, Malabar* (Edw.); *Nicobars* (Heller); *Zanzibar* (Hilgendorf); *New Caledonia* (A. M.-Edw.).

There is a considerable confusion regarding this species. Edwards considers this as the *Cancer vocans* of Linne. Linne in his tenth edition (p. 623, 1757) quotes Rumphius, Pl. XIV, f. E.; and Catesby's Carolina, ii, Pl. XXV. Rumphius' figure (of a specimen from Amboina) represents a form with the fingers regularly tapering, and resembling *G. tetragonon* more nearly than any other species with which I am acquainted, but the figure is not accurate enough to have any systematic value. Catesby's figure is the well-known *Ocypoda arenaria* of North America. Linne (in the *Amœnitates Academici*, vi, p. 416) gives a description, which does not at all apply to this species, and quotes in addition Marcgrave, Piso, Rumphius, Catesby, and Seba, in the order given, showing a still greater confusion. In his 12th edition, p. 1041, Gronovius and Petiver are added to the list, but no hints showing what should be regarded as the *Cancer vocans*. As there exists such confusion, it is impossible to apply the name *vocans*, with certainty, to any species, and for that reason I have thought it best to allow it to lapse into synonymy and take the first recognisable description for this species.

8. *Gelasimus marionis* Desmarest. Pl. ix, f. 8.

Gelasimus marionis Desm., Consid. sur le Crust., p. 124, Pl. XIII, f. 1 (1825); Edw., Ann. Sci. Nat., III, xviii, p. 145 (1852).

Carapax smooth, and with each margin terminated by an acute angle directed forward; an H-shaped impression on the carapax. Ocular peduncles slightly enlarged at the extremity, and without a terminal point. Inferior border of the orbit crenulate. Right hand greatly larger than the left, greatly compressed, basally granulate; finger straight, its sides smooth, its occludent margin granulate; thumb arcuate below, with its internal border broadly excavate in the middle, and armed with fine teeth. Length, 8 lines; breadth, one inch (Desmarest).

Manilla (Desm.). *Malabar* (Edw.).

I have not seen any form corresponding to this description or figure.

9. *Gelasimus dubius* Stimpson.

Gelasimus dubius Stm., Proc. Acad. Nat. Sci., Phila., 1858, p. 99.

Carapax and front as in *G. cultrimanus*. Inferior margin of orbit crenulate, externally angulate. Meros of larger cheliped spinulose, hand stout, externally granulate or tuberculate; in-

ternally with crests as in *G. cultrimanus*, but less prominent. Digits rather broad, externally sulcate; inner margin nearly straight, irregularly dentate, two or three teeth larger than the others (Stm.).

Loo Choo (Stm.).

10. *Gelasimus forcipatus* White. Pl. ix, f. 9.

Gelasimus forcipatus White, Catalogue Brit. Mus. Crust., p. 36, *sine descr.* (1847); Voyage Samarang Crust., p. 50 (1848). *Gelasimus coarctatus* Edwards, Ann. Sci. Nat., III. xviii, p. 146, Pl. III, f. 6 (1852); Heller, Crustaceen Sud. Europas, p. 100 (1863); Alph. Milne-Edwards, Nouv. Arch. du Mus. d'Hist. Nat., IX, p. 272, Pl. XII, f. 4 (1873).

Carapax convex, narrowed behind. Meros of larger cheliped externally granulate, its margins denticulate. Carpus granulate, inner margin produced but without a prominent tooth. Palm externally granulate, its upper border slightly margined, its lower tuberculate; on the inside a few tubercles in a curved line near the base of the dactylus, and an oblique line from the lower margin runs up to the articulation with the carpus, dactylus granulate at the base, otherwise the hand and fingers are smooth. Thumb regularly tapering, with an external impressed line, its occludent margin regularly arcuate, with generally a prominent tubercle near the middle. Dactylus with a prominent distal dentate lobe.

[?] *Odessa!* Guerin (Phil. Acad.). *Philippines!* Drs. Wilson and Burroughs (Phil. Acad.). *Australia!* E. Wilson (Phil. Acad.). *Borneo* (Adams and White). *Odessa* (Edw.). *New Caledonia* (A. M.-Edw.).

I have united these two nominal species from an actual comparison of specimens. In the collection of Guerin-Meneville now in the possession of the Philadelphia Academy, is a specimen labelled "*Gelasimus coarctatus* Edw., Cat. Mus., Paris, *Odessa*," and which was probably one of the original specimens which was the foundation of Edward's description. I am strongly inclined to doubt of the authenticity of the locality "*Odessa*," as I have been unable to find any other authority than that of Edwards. Marcussen in his Fauna of the Black Sea (Archiv. für Naturgeschichte xxxiii, pp. 358-363, 1867) does not mention it. His subsequent paper and that of Uljanin, I have not seen. Heller merely quotes from Milne-Edwards.

11. *Gelasimus arcuatus* De Haan. Pl. ix, f. 10.

Ocypode (*Gelasimus*) *arcuata* De Haan, Fauna Japonica, Crustacea, p. 53, Pl. VII, f. 2 (1835). *Gelasimus arcuatus* M.-Edw., Ann. Sci. Nat. III, xviii, p. 146 (1852); (?) Krauss, süd Afrikanische Crustaceen, p. 39 (1843); A. M.-Edw., Nouv. Arch. du Mus., ix, p. 273, (1873).

Carapax with sides carinate, carina acute, scarcely granulate; inferior margin of orbit granulate. Meros of larger cheliped, above concave, below flat; internally with an acute granular ridge. Carpus externally convex, above flat, hand twice the breadth of the carapax, fingers compressed, smooth, externally longitudinally sulcate (De Haan).

Japan (De Haan). *New Caledonia* (A. M.-Edw.). [?] *Natal Bay* (Krauss).

12. *Gelasimus tetragonon* Ruppell. Pl. ix, f. 11.

Seba Thesaurus, iii, Pl. XIX, f. 15. ? *Cancer serratan* Forskal, Descr. Animalium, etc., p. 87 (1775). *Cancer tetragonon* Herbst l. c., i, p. 257, Pl. XX, f. 110 (1790). *Gelasimus tetragonon* Ruppell, Beschreibung und Abbildung 24 Krabben des rothes Meeres, p. 25, Pl. V, f. 5 (1830); Edw., Hist. Crust., ii, p. 52 (1837); Ann. Sci. Nat. III, xviii, p. 147, Pl. III, f. 9 (1859); White, Cat. B. M. Crust., p. 36 (1847); Guérin, Voyage Coquille, p. 10 (1839¹); Heller Reise der Novara, p. 37 (1863); Hilgendorf in van der Decken, p. 84 (1867); Kossman Reise nach rothen Meeren, p. 52 (1877). *Gelasimus duperreyi* Guérin, l. c., Pl. I (1826); Dana, U. S. Ex. Crust., p. 317 (1852). *Gelasimus desjardini* Guérin, MS. *Gelasimus tetragonon* var *spinicarpa* Kossmann, l. c., p. 52. Kossman gives a reference to a paper by Poulson, but as the title is written in Russian I have not been able to verify it.

Carapax strongly arcuate, front not expanded below the eyes. Meros of the larger cheliped with the upper margin terminating distally in a strong spine, carpus smooth, the inner margin acute, its basal portion sometimes expanded into a strong tooth. Hand compressed, externally finely granulate, a shallow pit with coarse punctæ near the base of the thumb; internally granulate but without tubercular ridges; thumb with two prominences on the distal half; the finger regularly tapering.

Mauritius! Dr. Wilson, Guérin's Collection; *Tongatabou*! Wilkes Expedition; *Tahiti*! A. Garrett; *Sandwich Is*! Dr. W. N. Jones

¹ The title page of the volume bears the date 1830, but the introduction to the Crustacea and Arachnida is dated "15 Novembre, 1838," so that it is probable that the volume did not appear complete until 1839. The plates bear date 1826.

(Phila. Acad.); *Tahiti* and *Sandwich Is.*! A. Garrett (Peab. Acad.); *Red Sea* and *Nicobar Is.* (Heller); *Zanzibar* (Hilgendorf); *Bourbon* (Edwards); *New Caledonia* (A. Milne-Edwards).

13. *Gelasimus acutus* Stm.

Gelasimus acutus Stm., Proc. Phila. Acad., 1858, p. 99.

Carapax narrowed behind, anterolateral angles prominent, acute. marginal line distinct. Front narrow, not constricted, inferior margin of orbit crenulate, externally acute, internal suborbital lobe convex; a crest on the sub-hepatic region parallel to the inferior margin of the orbit, the included surface smooth. Larger hand coarsely granulate, a tubercular ridge on the inner surface. Fingers not longer than the palm, externally sulcate, inner margin dentate, median tooth larger, but no sub-terminal tooth (Stimpson).

Macao (Stimpson).

14. *Gelasimus forceps* Milne-Edwards. Pl. ix, f. 12.

Gelasimus forceps Edw., Hist. Nat. des Crust., ii, p. 52 (1837); Annales des Sciences Naturelles. III serie, tome xviii, p. 148, Pl. III, f. 11 (1852); White Cat. Brit. Mus. Crust., p. 36 (1847).

Carapax narrowed behind, lateral angles prominent, acute; orbits below with two denticulate margins. Meros and carpus smooth, the lower margin of the meros crenulate, upper cristate, finely dentate; hand smooth or indistinctly granulate, fingers long, slender, finely denticulate, the thumb with a distal lobe (Edwards).

Australia (Edwards, White).

I have not forms referable to the two foregoing species.

15. *Gelasimus longidigitum* (nov.). Pl. ix, f. 13.

Closely allied to *forceps* in shape of carapax, orbits below with a simple smooth margin. Meros and carpus smooth, the inner margin of the carpus acute, crenulate. Basal portion of the hand externally obscurely granulate; internally with an oblique tubercular ridge, and a few tubercles near the base of the fingers. Fingers compressed, long, finely denticulate, and narrower near the base than at the middle point.

Moreton Bay, Australia! E. Wilson.

16. *Gelasimus smithii* (nov.). Pl. ix, f. 14.

Carapax gibbous, front narrow; meros with a strong, oblique ridge on the upper outer surface, the inner upper margin produced into a prominent vertical crest. Carpus externally nearly smooth,

the inner margin slightly produced and denticulate. Palm externally granulate above, smooth below, its upper margin granulate and indistinctly indicated by an impressed line on the outer surface, and its inner surface smooth, without tubercular ridges, except one at the base of the fingers. Fingers long, slender, slightly compressed and regularly tapering, the extremity of the dactylus somewhat expanded and excavate.

Natal! E. Wilson (Phila. Acad.).

Named in honor of my friend Prof. S. I. Smith, of Yale College, who has monographed the American species of this genus.

17. *Gelasimus urvillei* M.-Edw. Pl. ix, f. 15.

Gelasimus urvillei M.-Edw., Ann. Sci. Nat., III, xviii p. 148, Pl. III, f. 10 (1852).

Resembles closely *G. forceps*, but has the medio-frontal sulcus nearly linear, and the fingers shorter, the anterior border of the meros of the larger cheliped obtuse and granulate (M.-Edw.).

Vanikoro (M.-Edw.).

18. *Gelasimus dussumieri* M.-Edw. Pl. x, f. 16.

Gelasimus dussumieri M.-Edw., Ann. Sci. Nat., III, xviii, Pl. IV, f. 12, (1852)? Hilgendorf in van der Decken's Reise in Ost Afrika, Crustaceen, p. 84, Pl. IV, f. 1 (1867); Alph. M.-Edw., Nouv. Arch. du Mus. d'Hist. Nat. IX, p. 274 (1873).

Resembles closely *G. urvillei*, but the accessory sub-orbital lobe is less marked, the median sulcus of the front entirely linear and the anterior border of the meros of the larger cheliped denticulate. Chela very large, *G. rubripes* is closely allied, but appears to be distinguished by the form of the fingers of the larger hand, the larger tubercles of the carpus, etc., (Ex. auct.).

Malabar and *Samarang* (Edw.); *New Caledonia* (A. M.-Edw.); *Zanzibar* (Hilgendorf).

19. *Gelasimus rubripes* Jacq. and Lucas. Pl. x, f. 17.

Gelasimus rubripes Jacquinot and Lucas, Voyage des Astrolabe et Zelee Crustacea, p. 66, Pl. VI, f. 2 (1853); Heller, Reise der Novara Crustaceen, p. 38 (1867).

Orbits granulate above and below, carpus of larger cheliped with the external portion granulate, its margins finely denticulate. Hand prominently granulate, internally smooth except fine granulations at the origin of the thumb; below strongly dentate, finger smooth except at the base where it is granulate; the inner margin of the thumb with three large teeth, the intervals between which

are finely denticulate. Thumb smooth below its inner margin with several rows of granulations and a prominent tooth near the middle (J. et L.).

Unknown (J. and L.) *Nicobars* (Heller).

20. *Gelasimus signatus* Hess. Pl. x, f. 18.

Gelasimus signatus Hess, Archiv für Naturgeschichte, xxxi, p. 146, Pl. VI, f. 6 (1865).

"Front between the eyes not so small as a *G. variatus*, cheliped one and a half times the breadth of the body; arm, carpus and hand bright red, fingers white. Arm below with two rows of pearly tubercles, fingers with an elevation at the middle of the inner border, distally arcuate and pointed" (Hess).

Sydney, Australia (Hess).

21. *Gelasimus crassipes* White. Pl. x, f. 19.

Gelasimus crassipes White, Cat. B. M. Crust., p. 36, sine descr.; Adams and White, Voyage Samarang Crustacea, p. 49 (1848).

? *G. brevipes* Edw., Ann. Sci. Nat., III, xviii, p. 146 (1852).

"Carapace very much arched, suddenly narrowed behind, front with a lobe without narrow stalk. Four hind pairs of legs thicker and stronger than in the other species" (Ad. and White).

Philippine Islands (White).

There have been described three other species* belonging to the narrow-fronted section, one of which has been made the type of the genus *Acanthoplax* by Milne Edwards. A fourth species from Bahia, Brazil, is in the collection of the Philadelphia Academy. So far as I am aware these are all females and are represented by only a single specimen each, and as I am strongly inclined to consider them the females of well-known forms I omit descriptions of them.

* *Gelasimus insignis* Smith, Trans. Conn. Acad., ii, p. 126 (1870). *Acanthoplax insignis* Edw., Ann. Sci. Nat., III, xviii, p. 151, Pl. IV, f. 23 (1852); Archives des Museum, vii, p. 162, Pl. II, f. 1 (1854).—Chili (Edw.).

Gelasimus ornatus Smith, Trans. Conn. Acad., ii, p. 125, Pl. II, f. 9, Pl. III, f. 5 (1870); Report Peabody Acad. Science, iii, p. 91 (1871).—West Coast Nicaragua! McNiel (Peab. Acad.).

Acanthoplax excellens Gerstäcker, Archiv für Naturgeschichte, xxii, p. 138 (1856).—No locality.

§ B. *Front broad between the orbits.*

* Male abdomen seven-jointed.

22. *Gelasimus vocator* Martens. Pl. x, f. 20.

Cancer vocator Herbst, Bd. iii, h. iv, p. 1, Pl. LIX, f. 1 (1804).

Gelasimus vocans Edw., Hist. Nat. Crust., ii, p. 54 (1837); Ill. Edit.

Règne Animal, Crustacea, Pl. XVIII, f. 1 (no date); White, Cat. B.

M. Crust., p. 36 (sine synon.), 1847.

Gelasimus vocans (pars) Gould, Invertebrata of Mass, p. 325 (1841).

Gelasimus vocans var. *a* Dekay, N. Y. Fauna Crustacea, p. 14, Pl. VI, f. 10 (1844).

Gelasimus palustris Edw., Ann. Sci. Nat., III, xviii, p. 148, Pl. IV, f. 13 (1852); Stimpson, Annals N. Y. Lyceum Nat. Hist., p. 62 (1860);

Smith, Trans. Conn. Acad., ii, p. 127 (1870).

Gelasimus pugillator Leconte, Proc. Acad. Nat. Sci., Philadelphia, 1855, p. 403.

Gelasimus brevifrons Stimps., Ann. N. Y. Lyceum, vii, p. 229 (1860); Smith, Trans. Conn. Acad., ii, p. 131 (1870); Lockington, Proc. Cal. Acad., vii, p. 147 (1877).

Gelasimus sp. Saussure, Memoirs Société Phys. et Hist. Nat. Genève, xiv, p. 440 (1858).

Gelasimus vocator Martens, Archiv für Naturgesch., xxxv, p. 1 (1869; xxxviii, p. 104 (1872); Kingsley, Proc. Phila. Acad., 1879, p. 400.

Gelasimus pugnax, mordax et rapax Smith, Trans. Conn. Acad., ii, pp. 131, 135, 134, Pls. II, f. 1, 2, 3, IV, 2, 3, 4 (1870).

Gelasimus affinis Streets, Proc. Phila. Acad., 1872, p. 131.

Gelasimus crenulatus Lockington, Proc. Cal. Acad., vii, p. 149 (1877).

Carapax smooth, meros of the larger cheliped with its margins denticulate or tuberculate, carpus externally granulate, internally with an oblique tubercular ridge. Hand tuberculate, its inner surface with a ridge running up from lower margin to carpal groove; in front of this are scattered granules. Thumb straight, extremity obliquely truncate, finger strongly arcuate, longer than the thumb.

East Coast of America, from Cape Cod! to Para, Brazil! West Indies! and Aspinwall! West Coast of Mexico! Panama!

The localities from which I have examined specimens number over thirty and embrace several hundred specimens. I find in the Guerin Collection two specimens from Mauritius which closely resemble Cuban forms.

This is, without much doubt, the species intended by Herbst; Edwards quotes the *Cancer palustris* of Sloane as this species, but aside from the fact that his History of Jamaica was published in 1725, and his name is therefore ante-Linnean (and is also poly-

nomial), Sloane gives not the slightest description, but says that it agrees perfectly with the figure of Marcgrave which is the *G. maracoani* of authors. I think that any one studying as I have large series of specimens, will agree with me in uniting these various forms under one specific name, as the characters which separate them are variable and not of specific importance. Probably *G. minax* should also be included here, as suggested by Professor Smith.

23. *Gelasimus minax* LeConte. Pl. x, f. 21.

Gelasimus minax LeConte, Proc. Phila. Acad., vii, p. 403 (1855); Smith, Trans. Conn. Acad., ii, p. 128, Pl. II, f. 4, Pl. IV, f. 1 (1870); Rep. U. S. Fish Commission for 1871-72, p. 545 (1875); Kingsley, Proc. Phila. Acad., 1879, p. 400.

Carapax strongly arcuate longitudinally, the branchial regions granulate anteriorly. Meros of larger chelipeds, with the upper and lower margins tuberculate as is the upper portion of carpus; inner margin of carpus with prominent tubercles, its inner surface with an oblique tubercular ridge. Palm cristate above, externally with large depressed tubercles above, smaller below, inner surface also tuberculate and with a ridge of tubercles running obliquely up from the lower margin at the base of the thumb to the depression into which the carpus folds, and a second curved one near the base of the fingers. Fingers long, slender, regularly tapering, finger longer than the thumb and distally strongly arcuate.

Besley's Point, Dennis Creek, N. J.! S. Ashmead (Phila. Acad., LeConte's types); *Bluffton, S. C.*! Dr. Mellichamp (Peab. Acad.); *Northampton Co., Va.*! H. E. Webster (Union College); *New Haven, Conn.*, and *St. Augustine, Fla.* (Smith).

24. *Gelasimus annulipes* M.-Edw. Pl. x, f. 22.

Gelasimus annulipes M.-Edw., Hist. Nat. Crust., II, p. 55, Pl. 18, f. 10-13 (1837); White, Cat. B. M. Crust., p. 36 (1847); Edw., Ann. Sci. Nat. III, xviii, p. 149, Pl. IV, f. 45 (1852); Dana, U. S. Ex. Crust., 317 (1852); Heller, Reise der Novara, Crustacea, p. 38 (1867); Hilgendorf in Baron Decken's Reise, p. 85 (1867); Monatsberichte Berliner Akademie, 1878, p. 803; Kossmann, Reise nach rothen Meeren, p. 53 (1873); Spence Bate in J. K. Lord's Naturalist in Vancouver. *Gelasimus macrodactylus* Edwards and Lucas in D'Orbigny's Voyage, 27, Pl. XI, f. 3 (1843); Nicollet in Gay's Hist. Chili Zool., iii, 165 (1840); Edw., Ann. Sci. Nat., III, xviii, 149 (1852). *Gelasimus lacteus* Krauss, Sud. Af. Crust., p. 39 (teste Hilgendorf). *Gelasimus pulchellus* Stimpson, Proc. Phila. Acad., 1858, p. 100. *Gelasimus annulipes* var *albinana* Kossmann l. c.. *Gelasimus rectilatus* Lockington, Proc. California Acad. Sci., p. 148 (1877).

Carapax transversely nearly flat; inferior margin of orbit crenulate. Meros of larger cheliped smooth, angles rounded, carpus the same with a few obsolete granulations on the upper surface. Hand smooth, sub-marginate below, an oblique row of tubercles on the inner surface, running up and back from near the lower margin half way to articulation with the carpus, and two similar curved lines near the articulation of the dactylus. Thumb regularly tapering, a prominent tubercle near the middle, extremity sub-excavate. Dactylus distally strongly curved, extending slightly beyond the thumb.

Australia! E. Wilson; *Singapore!* Dr. McCartee (Phila. Acad.); *Zanzibar!* (C. Cooke) "N. W. Boundary Survey, A. Campbell, Commr., Dr. C. B. Kennerly"! (Peabody Acad.); *Seas of India and Asia* (Edw.); *Ceylon, Nicobars Madras* (Heller); *Mozambique Inhambeni* (Hilgendorf); *Pondicherry* (White); *Valparaiso* (Edw. and Lucas); *Vancouver* (Bate); *Lower California* (Lockington); *Tahiti* (Stm.); *Red Sea* (Kossmann).

25. *Gelasimus lacteus* DeHaan. Pl. x, f. 28.

Ocypode (Gelasimus) lacteus DeHaan, Fauna Japonica Crust., p. 54, Pl. XV, f. 5 (1835). *Gelasimus lacteus* Edw., Ann. Sci. Nat., III, xviii, 150, Pl. IV, f. 16 (1852); Stm., Proc. Phila. Acad., 1858, 100; Miers, Proc. Zool. Soc., 1879, p. 36.

Carapax longitudinally strongly arcuate, transversely nearly flat; antero-lateral angles prominent; meros of larger cheliped externally granulate, a constriction of the upper margin near the articulation with the carpus, lower crenulate or even denticulate. Carpus externally smooth, inner edge acute denticulate; hand externally finely granulate, above more plainly so; a crenulated ridge near the inner lower margin and one or two near the fingers. Fingers elevated, strongly compressed, the thumb suddenly narrowed near the apex.

Japan! E. Wilson; *Pondicherry!* Dr. T. B. Wilson (Phila. Acad.); *Japan* (DeHaan); *China* (Edw. Stm.).

26. *Gelasimus splendidus* Stm.

Gelasimus splendidus Stm., Proc. Phila. Acad., 1858, p. 99.

Inferior margin of orbit crenulate, externally rounded. Larger hand nearly smooth, internally with an oblique tubercular crest. Crest at the base of the fingers nearly obsolete. Fingers long, slender, slightly denticulate. Thumb with the apex excavate (Stm.).

Hong Kong (Stm.).

I have not seen this species; it, however, appears to be very near *annulipes*.

27. *Gelasimus minor* Owen.

Gelasimus minor Owen, in Beechey's Voyage of the Blossom; Appendix; Crustacea, p. 76, Pl. XXIV, f. 2 (1831).

Oahu, Sandwich Is. (Owen).

This species is very near the *annulipes* of Edwards, the only difference being the larger teeth of the fingers of the cheliped.

28. *Gelasimus triangularis* A. M.-Edw.

Gelasimus triangularis A. M.-Edw., Nouv. Arch. du Mus., IX, p. 275, (1873).

Is distinguished from *cultrimanus*, *forcipatus*, *arcuatus*, *tetragonon*, *dussumieri*, *perplexus* et *latreillei* by the carapax greatly larger in front and smaller behind; the lateral angles are spiniform and directed strongly forward, the front between the eyes is large and rounded. Larger cheliped externally smooth, palmar portion long and proximally inflated. Inner surface with a granular ridge, inner margin of fingers dentate, finger a little longer than the thumb. This species is allied to *G. minor* by the form of the hand, but is distinguished by the more triangular carapax (A. M.-E.).

New Caledonia (A. M.-Edw.).

29. *Gelasimus gaimardi* Edw. Pl. x, f. 23.

Gelasimus gaimardi Edw., Ann. Sci. Nat. III, xviii. 150, Pl. IV, f. 17, (1852); Heller-Reise Novara, Crust., p. 38 (1867).

Very near *annulipes*, but having the front more prolonged and more rounded below and the external [internal?] crest of the hand obtuse and not denticulate, resembling that of *G. latreillei* (Edw.).

Tongatabou (Edw.); Tahiti (Heller).

30. *Gelasimus panamensis* Stm. Pl. x, f. 24.

Gelasimus panamensis Stm., Ann. Lyc., VII, p. 63 (1860); Smith, Trans. Conn. Acad., II, 137, Pl. IV, f. 5 (1870).

Carapax depressed. Anterior and inferior margins of the meros of the larger cheliped crenulated, posterior rounded. Carpus very short, smooth; hand smooth externally and internally, fingers regularly tapering.

Gulf of Fonseca! McNiel (Peab. Acad.).

31. *Gelasimus pugillator*.

Ocypoda pugillator Bosc., Hist. Nat. Crust., Edit. I, i, p. 197, 1802-3, (teste Auct.) Edit. II, i, p. 250 (1828); Latr. Hist. Crust. et Ins. vi, 47 (1803-4). *Ocypoda pugillator* (pars.), Say, Jour. Phila. Acad. I,

71 and 443 (1817-18). *Gelasimus pugillator* Latr., Nouv. Dict. d'Hist. Nat. Edit. II, p. 519 (1817); Desmarest Consid. 123 (1825), Edw., Ann. Sci. Nat. tom. cit. p. Pl. IV, f. 14 (1852); Stm. Ann. N. Y. Lyc. VII, p. 62 (1859); Smith Trans. Conn. Acad. II, p. 136, Pl. IV, f. 7 (1870); Rep. U. S. Fish Comm. 1871-72, p. 545 (1875). *Gelasimus vocans* (pars.), Gould, Invertebrata of Massachusetts, p. 325 (1841); Dekay, N. Y. Fauna, Crust., 14, Pl. VI, f. 9 (1844).

Carapax polished, swollen, nearly quadrate. Meros of the larger cheliped with the outer surface rugose, upper and lower margins crenulate. Carpus granulate externally, its inner margin acute; hand inflated, the basal portion granulate and margined above and below; inner surface rounded, granulate, but without any trace of a tuberculate ridge except one formed by a continuation of the inner margin of the thumb. Thumb nearly straight, a ridge on the outer surface, a large tubercle near the middle of the inner margin, the extremity obliquely truncate. The finger is longer than the thumb, regularly tapering and distally strongly arcuate. There is a specimen in the collection of the Philadelphia Academy from Surinam which appears to be intermediate, in the characters of the hand, between this and *G. vocator*. The fingers are shorter, the granules on the outside of the palm much more prominent than in typical *pugillator*, and there are traces, though faintly indicated of a tubercular ridge on the inside of the palm.

New Jersey! T. Say, Wm. Wood; *Manatee River!* S. Ashmead; *Mauritius!* Guerin's Collection; *Greenpoint, L. I.!* S. F. Baird; *Boston Harbor!* J. H. Slack (Phila. Acad.); *Nantucket* and *Key West, Fla.!* A. S. Packard; *Bluffton, S. C.!* Dr. Mellichamp; *Savannah, Ga.!* no collector's name given (Peab. Acad.); *Beaufort, N. C.!* H. E. Webster (Union College); *New Haven, Conn., Egmont Key* and *St. Augustine, Fla.* (Smith); *South Carolina* and *Cayenne* (Edw.).

32. *Gelasimus chlorophthalmus* Edw. Pl. xy, f. 26, 27.

Gelasimus chlorophthalmus Edw., Hist. Nat. Crust. II, 54 (1837); Ann. Sci. Nat. tom. cit. 150, Pl. IV, f. 19 (1852); McLeay in Smith's Zool. S. Africa, p. 64 (1838); White, Cat. B. M. Crust., p. 36 (1847); Guerin, Iconog. Crust., Pl. IV, f. 3; Hilgendorf in Decken's Reise Crust. p. 85 (1867); Monatsberichte Berlin Akad., 1878, p. 803; *Gelasimus marionis* Edw., Hist. Nat. Crust., II, 53 (1837); *Gelasimus perplexus* Edw., Ann. Sci. Nat. tom. cit., 150, Pl. IV., f. 18 (1852); Heller, Novara Crust. p. 38, Pl. V, f. 4 (1867); A. M.-Edw. Nouv. Arch. Mus. IX, 274 (1873); teste Hilgendorf.

Carapax arcuate. Larger hand small, joints all smooth, fingers short, frequently shorter than the palm; the ridges on the inside of the palm either smooth or obsoletely granulate; fingers denticulate, regularly arcuate.

Island of Bourou! Guerin's Collection (Phila. Academy); *Mauritius* (Edw., White); *Zanzibar, Mozambique* and *Mascarenes* (Hilgendorf); *Java* (Edw.), *Ceylon* and *Madras* (Heller; *New Caledonia* (A. M. Edw.).

I also understand that Maillard found this species at Reunion, but I have not seen the work.

Hilgendorf from an actual comparison of specimens says that the *perplexus* and *chlorophthalmus* of Edwards are the same. The *G. stenodactylus* of Lockington (Proc. California Acad., vii, p. 148, 1877), from West Coast of Lower California, would appear from the description and a rough figure of the hand sent me by the author to be near this species; it certainly is not *stenodactylus* of Edwards and Lucas.

33. *Gelasimus subcylindricus* Stimpson. Pl. x, f. 29.

Gelasimus subcylindricus Stimpson, Ann. N. Y. Lyc., vii, p. 63 (1859); Smith, Trans. Conn. Acad., ii, p. 137, Pl. IV, f. 6 (1870).

Carapax obscurely granulate. Margins of meros of larger cheliped granulous. Hand internally without tubercular ridge except two or three parallel curved rows near the base of the fingers, externally granulate. Fingers closely resembling those of *G. vocator*, the common east coast form (Smith).

Matamoras on the *Rio Grande* (Smith, Stm.).

34. *Gelasimus latreillei* Edw. Pl. x, f. 31.

Gelasimus latreillei Edw., Ann. Sci. Nat., III, xviii, p. 150, Pl. IV, f. 20 (1852); A. M. Edw., Nouv. Arch. Mus., ix (1873).

Carapax smooth, lateral angles far behind the front. Greater cheliped smooth; meros with the upper and posterior margins rounded, the upper ending in a prominent tubercle, the lower crenulate and prominent. Inner upper margin of carpus minutely crenulate, the others rounded. Hand cristate above, externally microscopically granulate, internally with a smooth ridge near the lower margin, no tubercles present; fingers slender, slightly compressed, regularly arcuate, with fine tuberculations on the occludent margins, the extremity of the thumb subexcavate.

Philippines! Dr. T. B. Wilson (Phila. Academy); *Isle of Borabora* (Edw.); *New Caledonia* (A. M. Edw.).

35. *Gelasimus tangieri* Eydoux. Pl. x, f. 30.

Gelasimus tangieri Eydoux, *Magazin de Zoologie*, 1835, clvii, Pl. XVII; Edw., *Ann. Sci. Nat.*, 1852, p. 151, Pl. IV, f. 21; Heller, *Crustaceen des südlichen Europas*, p. 101 (1863).

Carapax transversely nearly flat, the sides of the branchial regions strongly arcuate; above everywhere granulate; lower margin of orbit bimarginate. Meros of larger cheliped externally roughened, the upper margin produced into an arcuate crest which is fringed with hairs, the lower margin with two rows of tubercles. Carpus elongate, externally with prominent tubercles, an oblique ridge on the inner surface with a slender obtuse spine at about the middle. Palm margined above, and armed with spiniform tubercles, externally with depressed tubercles, inferior margin denticulate to the tip of the thumb; internally a row of tubercles near the base of the fingers, a second runs obliquely upward from the lower margin, meeting a third running backward from the articulation of the finger, elsewhere internally smooth. Fingers elevated, strongly compressed. Dactylus with the upper margin and outer basal surface tuberculate; the rest of the outer surface finely granulate. Occludent margins of both fingers with three rows of tubercles, the margin of the finger regularly arcuate, that of the thumb with a prominence near the middle. Meral joints of the ambulatory feet denticulate above and below.

Tangier! Guérin's Collection (Eydoux's Types); *West Africa!* (Duchailu); [?] *Bahia!* E. Wilson (Phila. Acad.); *Cadiz and Coasts of Morocco!* (Edwards).

Edwards' figure is very poor.

36. *Gelasimus perlatus* Herklots. Pl. x, f. 25.

Gelasimus perlatus Herklots, *Additamenta ad Faunam*, p. 16 (1851); Edw., *Ann. Sci. Nat.*, III, xviii, p. 151 (1852); Hilgendorf, *Monatsberichte Berlin. Akad.*, 1878, p. 806.

Carapax arcuate in both directions, above with patches of granules more prominent on the anterolateral portions. Larger cheliped much smaller than is usual in the genus. Meros granulate, the posterior margin rounded, the anterior produced in an arcuate crest; carpus and hand externally granulate. Hand cristate above, internally without tubercular ridges, fingers compressed.

Guinea! E. Wilson (Phila. Academy); *Boutry, West Coast of Africa.* (Herklots); *Loando, Chinchozo, Liberia* (Hilgendorf).

This species is closely allied to *tangieri*, but differs in the proportionately smaller cheliped without tubercular ridges on the inner surface and in the more sparse tuberculation of the carapax.

* * Male Abdomen five-jointed.

37. *Gelasimus stenodactylus* Edw. et Lucas. Pl. x, f. 33-35.

Gelasimus stenodactylus Edw. and Lucas, in D'Orbigny's Voyage Crust. p. 26, Pl. XI, f. 2 (1843); Nicolle in Gay's Hist. of Chili, Zoologie iii, p. 165 (1849); Edw. Ann. Sci. Nat. III, xviii, 149 (1852). *Gelasimus gibbosus* Smith, Trans. Conn. Acad., II, p. 141, Pl. II, f. 11, Pl. IV, f. 8 (1870), Lockington, l. c. *Gelasimus leptodactylus et poeyi* Guérin MS.

Carapax smooth, transversely flat, the regions strongly gibbous. Meros and carpus of larger cheliped elongate, meros smooth, its angles rounded, carpus externally unobscurely granulate, its inner margin acute denticulate. Hand externally smooth or granulate, a tubercular ridge on the inside of the palm, running obliquely from the lower margin to the groove in which the carpus folds. Fingers much longer than the palm, internally denticulate.

Mexico! Cuba! Brazil! Guérin's Collection (Phila. Acad.); *Gulf of Fonseca!* McNeil (Peab. Acad.); *Gulf of California!* W. N. Lockington (Brown University); *Vulparaíso* (Edw. and Luc.).

Of the following species I can say but little. I have not seen specimens which would answer to the descriptions and figures, while the descriptions are so meagre that I cannot decide regarding their affinities.

38. *Gelasimus variegatus* Heller, Verhandlung der Zool. Bot. Gesellschaft, Wien, 1862, p. 521.

"*G. annulari* affinis sed brachium chelipedum ad marginem superiorem carinatum et dentatum, index dactylo paulo brevior acuminatus. *Madras.*"

This is described as one of the specimens collected by the Novara in her voyage around the world, but in Dr. Heller's final memoir on the Crustacea of that expedition, this species is not mentioned.

39. *Gelasimus variatus* Hess, Archiv. für Naturgeschichte, XXXI, 146, Pl. VI, f. 7 (1865). Pl. x, f. 32.

Cephalothorax smooth, greatly swollen. Front between the eyes small. Greater cheliped of male somewhat longer than the breadth of the carapax. There is a large triangular depression at

the base of the index finger; the index finger is somewhat bent, the thumb is straight; both are tuberculate on the inner margin.

Sydney, Australia.

40. *Gelasimus porcellanus* White, Cat. B. M. Crust., p. 36 (sine descr.), Adams and White, Voyage of the Samarang, Crustacea, p. 50 (1848), Edw., Ann. Sci. Nat., III, xviii, p. 151 (1852).

"Eye pedicels very long, frontal portion of carapax not narrowed at the base; hind part of carapax much longer than the sides. Fore-legs with the lower claws thickened at the end, the inner margins of both claws with four larger tubercles amongst the smaller crenules. Hab., Borneo." (Adams and White.)

41. *Gelasimus inversus* Hoffmann, Rech. Faun., Madagascar, p. 29, Pl. IV, f. 23-26.

Madagascar.

I have never seen this work, the quotation being taken from the Zoological Record.

EXPLANATION OF PLATES.

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| 1. <i>G. maracoani.</i> | 19. <i>G. brevipes</i> (after Milne-Edw.). |
| 2. <i>G. heterocheles.</i> | 20. <i>G. vocator.</i> |
| 3. <i>G. bellator.</i> | 21. <i>G. minax</i> (drawn from type). |
| 4. <i>G. styliiferus</i> (after Milne-Edw.) | 22. <i>G. annulipes.</i> |
| 5. <i>G. heterophthalmus.</i> | 23. <i>G. gaimardi.</i> |
| 6. <i>G. heteropleurus.</i> | 24. <i>G. panamensis.</i> |
| 7. <i>G. cultrimanus.</i> | 25. <i>G. perlatus.</i> |
| 8. <i>G. marionis</i> (after Desmarest). | 26. <i>G. chlorophthalmus.</i> |
| 9. <i>G. forcipatus.</i> | 27. <i>G. perplexus</i> (after Edwards). |
| 10. <i>G. arcuatus.</i> | 28. <i>G. lacteus.</i> |
| 11. <i>G. tetragonon.</i> | 29. <i>G. subcylindricus</i> (after Smith). |
| 12. <i>G. forceps</i> (after Milne-Edwards). | 30. <i>G. tangieri</i> (from type). |
| 13. <i>G. longidigitum.</i> | 31. <i>G. latreillei.</i> |
| 14. <i>G. smithii.</i> | 32. <i>G. variatus</i> (after Hess). |
| 15. <i>G. urvillei</i> (after Milne-Edw.). | 33. <i>G. stenodactylus</i> (from Brazil). |
| 16. <i>G. dussumieri</i> (after Milne-Edw.). | 34. <i>G. stenodactylus</i> (after Edwards
et Lucas). |
| 17. <i>G. rubripes</i> (after Hombron et
Jacquinot). | 35. <i>G. stenodactylus</i> (from Mexico). |
| 18. <i>G. signatus</i> (after Hess). | |

APRIL 6.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-two persons present.

The death of Wm. Theodore Ræpper, a correspondent, was announced.

APRIL 13.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-eight persons present.

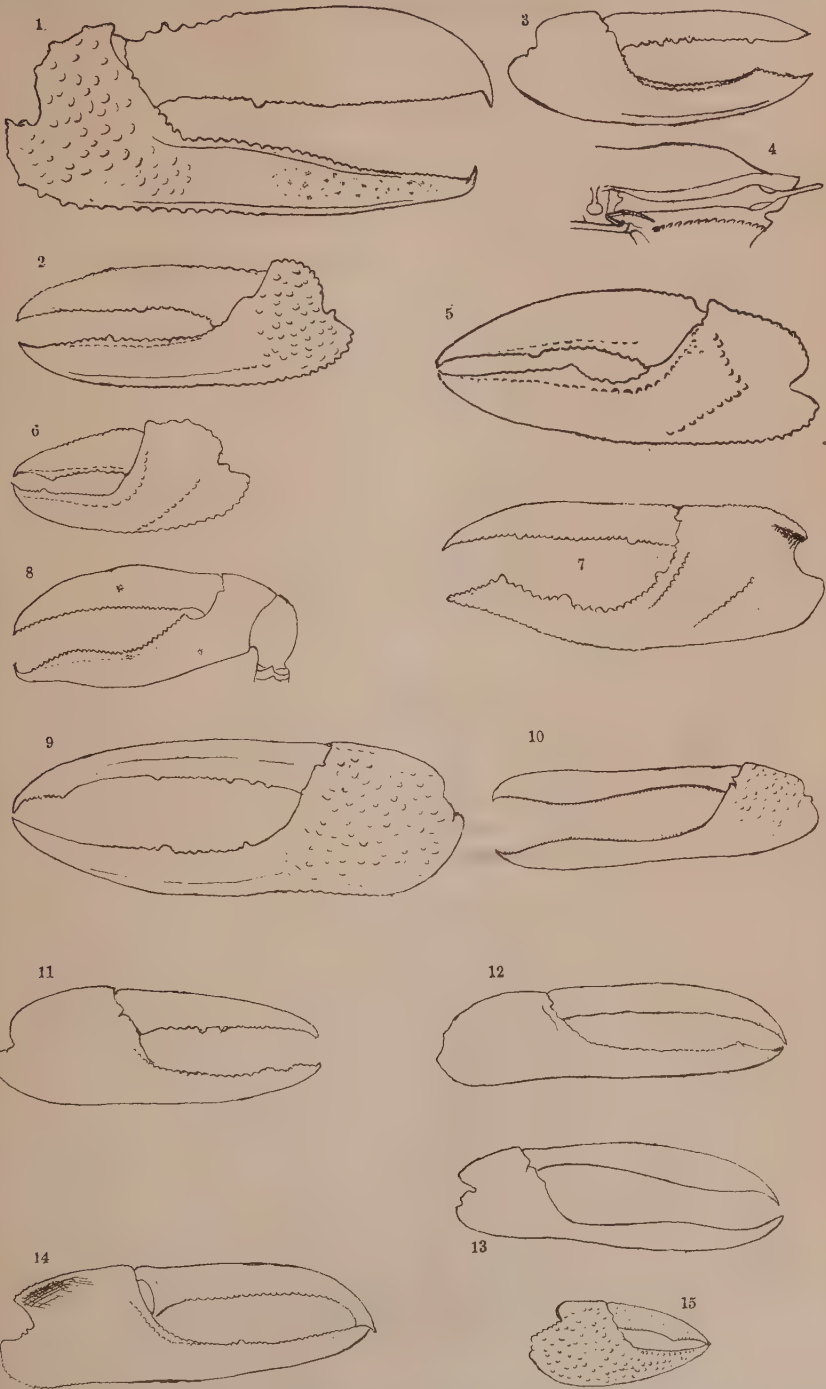
A paper entitled "Description of a New Species of *Catostomus* (*C. cypho*), from the Colorado River," by Wm. N. Lockington, was presented for publication.

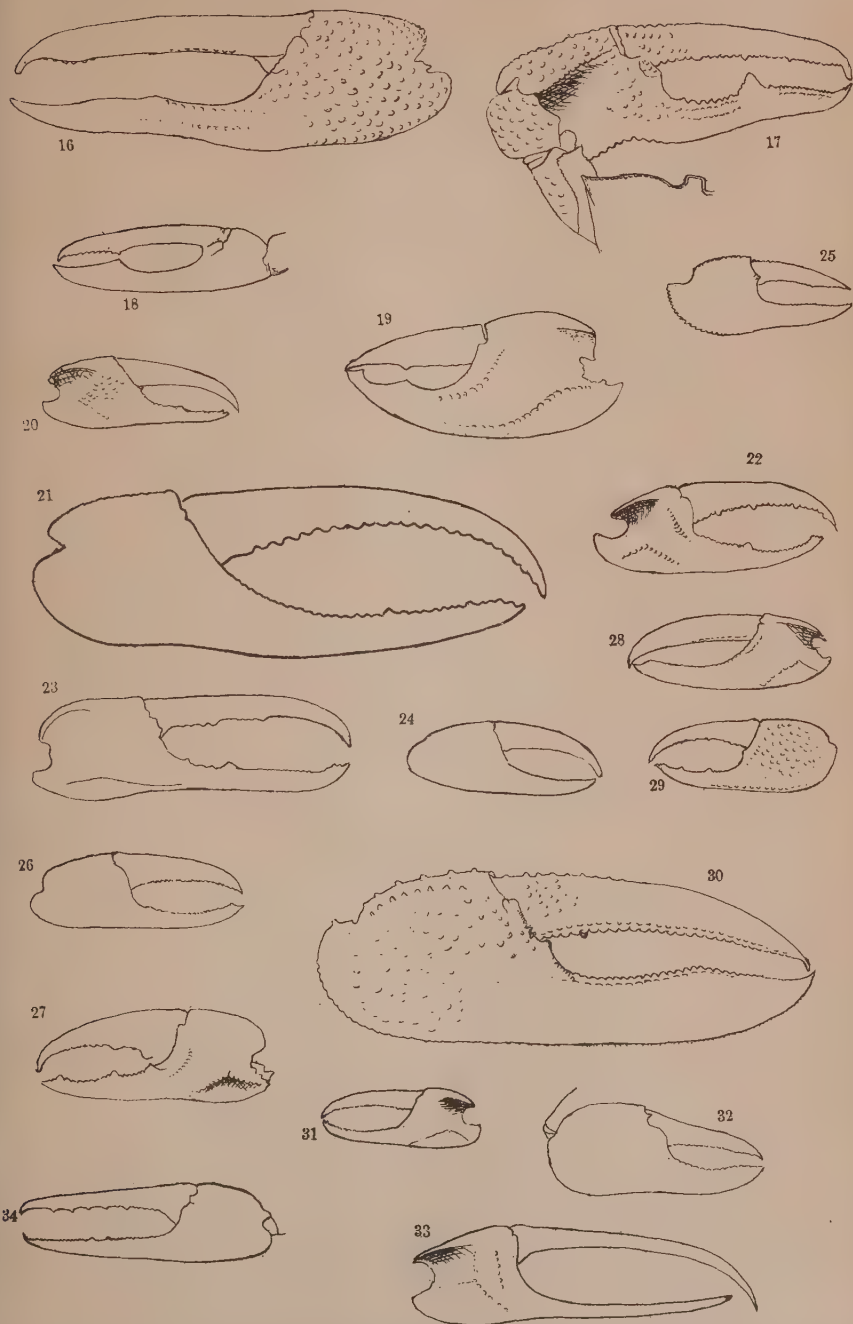
The death of M. Laporte, Count de Castelnau, a correspondent, was announced.

Remarks on Pond Life.—Prof. Leidy remarked, that at the invitation of Mr. Joseph W. Griscom, he had recently visited some little ponds in the vicinity of Woodbury, New Jersey, which were remarkable for the profusion of minute invertebrate life. The ponds occupy hollows in the woods, and consist mostly of accumulated rain water, though several are likewise supplied by springs. Several are completely dried up during the summer. Mr. Griscom says they continue rich in animal life even during the winter.

Of animals, entomostracans are exceedingly numerous and varied. Among some of the most beautiful and conspicuous were noticed abundance of *Branchipus*, of which two species from the same locality have been recently described by Mr. Ryder, under the names of *Chirocephalus holmanii* and *Streptocephalus scalii*. There are also wonderful multitudes of many species of copepods, ostracods and cladoceres, several of which are conspicuous for their large size and bright red color.

In one of the ponds a bright green *Hydra* was frequent, and in another a pinkish one was abundant. These appear to be the *H. gracilis* and *H. carnea* of Agassiz, but it is a question whether they are not the same as the *H. viridis* and *H. fusca* of Europe. Some of the Hydras were of a bright red color, and Mr. Griscom intimated that this was due to the pinkish variety feeding on red entomostracans. This was confirmed by some of the pink ones which were brought home and kept in a jar with abundance of





CARCINOLOGICAL NOTES, No. 3.—REVISION OF THE GENUS OCYPODA.

BY J. S. KINGSLEY.

The following paper is based on the Collections of the Academy. I have observed the rule adopted in previous papers of following the locality from which I have seen specimens, by an exclamation point. In all other cases the name of the person who has reported a species from any place follows that of the locality. The same conservative spirit which pervades my paper on the "Fiddler Crabs" (*Gelasini*) will be found in this. Many of the characters given by authors prove to be of no specific value, but I have not ventured to unite forms unless I had specimens which corresponded to each nominal species.

OCYPODA Fabricius.

Cancer l. c., Fabr. *Ocypoda* Fabr., Suppl. Ent. Syst., 347 (1798); Edw., Hist. Nat. Crust., ii, p. 41 (1837); Dana, U. S. Ex. Crust., p. 324 (1852).

Carapax transverse, rhomboidal or nearly square. Eyes stout, the cornea occupying the larger portion. Meros of external maxillipeds shorter than ischium. Chelipeds unequal.

In many species there is a stridulating organ composed of a row of tubercles on the inner surface of the palm, which, by being drawn across a ridge on the ischium of the cheliped, produces a noise.

§ 1. *Ocular pedicels prolonged beyond the cornea as a spine or style.*

1. *O. ceratophthalma* Fabr.

Cancer ceratophthalmus Pallas, *Spicelegia*, p. 83, Pl. V, f. 17 (1772).

Ocypoda ceratophthalma Fabr., l. c., 347 (1788); Latreille, Hist. Crust. et Ins., vi, 47 (1803-4); Encyc. Meth., x, Pl. 274, f. 1; Lamarck, Hist. Animaux sans Vert., v, 252 (1818); Desmarest, Consid. sur le Crustacés, 121, Pl. XII, f. 1 (1825); Edw., Hist. Nat. Crust., ii, p. 48 (1837); III. Edit. Regne Animal, Pl. XVII, f. 1; Ann. Sci. Nat., III, xviii, p. 141 (1852); Krauss, S. African Crust., p. 41 (1843); Stimpson, Proc. Phila. Acad., 1858, p. 100; Hess, Archiv. für Naturgeschichte, XXXI, 143 (1865); Martens, Verhandl. Zool. Bot. Gesellsch. Wien, 1866, p. 381; Heller, Reise Novara, Crust., p. 42 (1867); Hilgendorf in v. Decken's Reise, Crust., p. 82, 1867; A. M.-Edw., Nouv. Arch. du Mus., ix, p. 270 (1873). *Cancer cursor* Herbst., Pl. I, f. 8-9 (1790). *Ocypoda brevicornis* Edw.,

Hist. Crust., ii, 48 (1837); Ann. Sci. Nat., III, xviii, 142 (1852); Dana, U. S. Ex. Crust., p. 326, Pl. XX, f. 3 (1852). *Ocypoda brevicornis* var *longicornuta* Dana, l. c., 327, Pl. XX, f. 4 (1852). *Ocypoda ægyptica* Gerstaecker, Archiv. für Naturgeschichte, xxii, 134 (1856); Heller, Sitzungsberichte Wien Akad., xliii, p. 361 (1861); Hoffmann, Rech. Fauna Madagascar Crust., p. 14 (1874 teste Zool. Record); Miers, Ann. and Mag. Nat. Hist., V, ii, 409 (1878).

Carapax nearly square, granulate, front strongly deflexed, orbits sinuate, oblique, the lateral angles being far behind the front. These angles are nearly right angles. Orbits with an indistinct fissure below. Eyes terminated with a style which in most cases is long and cylindrical, extending far beyond the orbits. In the young, however, it is small and in some cases even wanting; that form, when small and conical, characterizes the nominal species *brevicornis*; maxillipeds granulate. Meropods of larger cheliped, with the margins armed with spiniform tubercles, more prominent on the anterior margins. Carpus granulate, with internally one or two teeth. Hand externally acute, tuberculate, serrate below, the inner surface with scattered tubercles. Stridulating ridge at some distance from the base of the fingers, straight and composed of rounded tubercles. Ambulatory feet with acute granules, which exhibit a tendency to arrange themselves in rugæ.

Natal! (E. Wilson); *Mauritius!* (Guerin's Collection); *Anjir*, *Ternate*, *Amboina*, *Adenare*, *Zanzibar*, *Benkula* (Hilgendorf); *Sandwich Is.*, *Tahiti*, *Bonin*, *Loo Choo*, *Hong Kong* *Ouisma* (Stm.); *Egypt*, *Mauritius*, *Bombay*, *Australia* (Edw.); *Ceylon* and *Nicobars* (Heller); *Madagascar* (Hoffmann); *Tongatabu* (Dana).

A specimen collected by the Wilkes Expedition ("East Indies") has the carapax intermediate between this species and *cursor*. The ocular styles are wanting. Milne-Edwards' figure in the Règne Animal is different from any specimens that I have seen. I agree with Kossmann in considering *ægyptica* as but a variety of *ceratophthalma*.

2. *O. platytarsis* Edw.

Ocypoda platytarsis Edw., Ann. Sci. Nat., III, xviii, p. 141 (1852); Heller, Reise Novara Crust., p. 42 (1867).

Carapax wider than is usual in this genus and covered with large granules. Superior margin of orbit sinuate, the external angles rounded; sides parallel about one-fourth of their length. Orbits with an indistinct fissure below. Eyes spined as in *ceratoph-*

thalma (teste Edw., the single specimen I have seen has the eyes broken). External maxillipeds granulate; meros of larger cheliped with the upper margin produced and dentate, the lower spined, the posterior with transverse granular rugæ, carpus granulate; hand with large granules, serrate below, stridulating ridges carved and composed of crowded granules. Ambulatory feet with rugæ and subspiniiform tubercles, dactyli broad.

Pondicherry! Guérin's Collection (labelled by Guérin "*Ocypoda platytarsis*, Edw., Cat. Mus., Paris") and probably one of the original specimens). *Tahiti* and *Nicobars* (Heller).

3. *O. urvillei* Guérin.

Ocypoda urvillei Guérin, Voyage Coquille, Crust. p. 9, Pl. I, f. 1 (1836), Edw. Hist. Crust., II, p. 49 (1837), Ann. Sci. Nat. III, xviii, p. 141 (1852), Owen in Beechey's Voyage Crust., p. 80 (1839), Dana, U. S. Ex. Exp. Crust., 328, Pl. XX, f. 5 (1852).

Carapax wider than long, superior margin of orbit sinuate, angles acute. Eyes moderate, ocular spines short, extending only to angles of orbit. Meros of larger cheliped rounded above, its two other margins denticulate. Carpus with a strong internal spine. Hand externally granulate, serrate above and below; the stridulating ridge nearly straight, a little remote from the fingers and extending from the lower margin of the hand two-thirds of the way to the upper. (Guérin.)

Tahiti (Guérin); *Isle Bouron* (Edw.); *Sandwich Is.* (Dana).

4. *O. macrocera* Edw.

Ocypoda macrocera Edw. Hist. Nat. Crust., II, 49 (1837), Ann. Sci. Nat. IV, xviii, p. 142 (1852), Heller, Novara Crust., p. 142 (1867).

Orbits wide, oblique, angle obtuse, eyes with a spine as in *O. ceratophthalma*. Larger hand very short, broad and a little spinose above; its palmar portion broader than long. The fingers of the smaller hand lamellate and very broad at their extremities. Ambulatory feet roughened above. (Edw.)

E. Indies, Pondicherry, [?] *Brazil* (Edw.); *Tahiti, Nicobars* (Heller).

5. *O. gaudichaudi* Edwards et Lucas.

Ocypoda gaudichaudi Edw. et Lucas in D'Orbigny's Voyage, Crust., p. 26, Pl. XI, f. 4 (1843, Edw. Ann. Sci. Nat. III, xviii, 142 (1852), Nicollet in Gay's Chili, Zool. III, p. 163 (1849), Stimpson, Ann. N.Y. Lyc. Nat. Hist., VII, p. 61 (1859); Smith, Rep. Peab. Acad. Sci., III, p. 91 (1871); Streets, Proc. Phila. Acad., 1872, p. 240.

Carapax longitudinally strongly arcuate, distal portion of front nearly vertical. Superior border of orbit sinuate internally, its

external three-fourths nearly straight and directed slightly backwards. Lateral angles nearly right angles, the sides behind them being concave for about a fifth of the length of the carapax; orbits with a deep median fissure below. Eyes with a short conical style reaching to, or slightly beyond, the angle of the orbit. External maxillipeds nearly smooth, or with a few inconspicuous granules. Meros of larger cheliped with the upper and lower margins spino-tuberculate, the posterior with transverse rugæ. Carpus granulate; hand subspinose above, finely serrate below, internally granulate and with a well-marked transverse stridulating ridge, fingers lamellate, the extremities truncate.

Chili! Guerin; *Panama!* Capt. Field and McNeil (Phila. Acad.); *Gulf of Fonseca!* McNeil (Peab. Acad.); *Callao* (Edw. et Lucas); *Valparaiso* (Dana).

6. *O. fabricii* Edw.

Ocypoda fabricii Edw., Hist. Nat. Crust., II, p. 47 (1837), Ann. Sci. Nat. XVIII, p. 142 (1852), Hilgendorf in Decken's Reise Crust., 82, Pl. III, f. 1 (1867).

Carapax convex, finely granulate, front strongly deflexed, orbits strongly sinuate; lateral angles acute and some distance posterior to the base of the rostrum; sides parallel for about a third of the length of the carapax. Orbits without emargination below; eyes with a short conical style, not reaching beyond the orbital angle. Anterior margin of meros of larger cheliped crenulate, distally spinose, posterior margin rounded, rugose. Carpus granulate, as is the outside of the hand; inner surface of the hand polished, with minute scattered granules; stridulating ridge straight, composed of small, closely set granules; lower margin of hand finely serrate; fingers of moderate length. Joints of ambulatory feet with transverse rugæ.

Australia! E. Wilson; *Natal!* E. Wilson; *Oceanica* (Edw.); *Zanzibar* (Hilgendorf).

7. *O. cursor*.

Cancer cursor Linn., Syst. Nat. Edit., xii, p. 1039 (1766). *Ocypoda ippeus* Olivier, Voyage, p. 234, Pl. XXX, f. 1 (1807); Savigny, Egypt, Pl. I, f. 1; Lamarck, An. sans Vert., v, p. 252 (1817); Desm., Consid. Crust., p. 121 (1825); Edw., Hist. Crust., ii, p. 47 (1837); Moseley, Notes by a Naturalist on the Challenger, pp. 48-49, woodcut, 1879. *Ocypoda cursor* DeHaan, Fauna Japonica, Crust., p. 29; Edw., Ann. Sci. Nat., III, xviii, p. 142 (1852); Stm., Proc. Phila. Acad., 1858, p. 100; Heller, Crust. S. Europa, p. 99 (1863).

Carapax arcuate, front strongly depressed. Upper margin of orbits but slightly sinuate and nearly transverse. Lateral angles acute, the sides converging posteriorly, making the carapax widest at the angles. Orbits below with a slight median fissure. Eyes terminated by a short conical style armed with pencil of hairs. Meral joint of cheliped with the spines and rugæ much less prominent than in *O. ceratophthalma*. Carpus internally with a denticulated tooth. Hands small, externally with depressed granules, the lower margin finely serrate, the upper rounded and without spiniform tubercles. Internally the hand is nearly smooth except below where there are granules similar to those of the outside. The stridulating ridge is very near the fingers and is crossed by numerous fine striæ. The propodal joints of the ambulatory feet spined below, the dactyli of the second pair hairy.

Senegal! (Guerin); *Syria, Egypt* (Edw.); *Cape Verdes* (Auct.); *Greece* (Guerin).

This is probably the species described by Hasselquist (*Iter Palestinum*, p. 433, 1757) under the name *Cancer anomalus*, but he gives many characters which will apply to no known decapod and so to avoid confusion I refrain from applying his name to this species. McLeay, in Smith's *Zoology of South Africa*, mentions "*Ceratophthalma cursor* DeHaan," an expression not to be found in the pages of that Dutch Carcinologist.

8. *O. ryderi* Nov.

Carapax coarsely granulate, the upper margins of the orbits sinuate, transverse, lateral angles acute, sides arcuate, the carapax being widest at the anterior third, as in *O. arenaria*, the lateral margins anteriorly finely serrate.

Eyes not reaching the extremities of the orbits, terminated by a minute spine. Chelipeds like those of *O. arenaria*; ambulatory feet roughened by subspiniform granules.

Natal! (E. Wilson).

This species is closely allied to the *Ocypoda arenaria* of the coasts of America, but is readily separated by the ocular spines and the granulations on the ambulatory feet. It is dedicated to my friend, John A. Ryder, of the Academy of Natural Sciences of Philadelphia.

§ II. *Eyes without an ocular spine.*

9. *O. arenaria* Say.

Cancer arenarius Catesby, History of the Carolinas, ii, Pl. 35 (1731 and 1771*). *Cancer quadratus* Fabr., Ent. Syst., ii, p. 439 (1793). *Ocyroda quadrata* Fab., Suppl., p. 347 (1798); Bosc. Edit., I, "i, p. 194;" (teste Auct.) Edit., II, i, p. 247 (1828; Latr., Hist. Crust. et Ins., vi, p. 49 (1803-4). *Ocyroda arenaria* Say, Jour. Acad. Nat. Sci., Phila., i, p. 69 (1817); Edw., Hist. Nat. Crust., ii, p. 44, Pl. XIX, f. 13-14 (1837); DeKay, N. Y. Fauna, Crust., p. 13 (1841); Gibbes, Proc. Am. Assoc., iii, p. 180 (1851); Gerstäcker, Arch. für Naturg., xxii, p. 36 (1856; Guerin in La Sagra's Hist. Cuba, Crust., p. 7 (1857); Martens, Arch. für Naturges., xxxviii, p. 103 (1872; Smith. U. S. Fish Comm. Report for 1871-72, p. 545 (1875); Kingsley, Proc. Phila. Acad., 1878, p. 322. *Ocyroda albicans* Latr., Encyc. Méth., x, Pl. 285, f. 1 (after Catesby vix *O. albicans* Bosc.). *Ocyroda rhombea* Edw., Hist. Nat. Crust., ii, p. 46 (1837); Ann. Sci. Nat., III, xviii, p. 143 (1852); Gibbes, l. c., p. 180 (1851); Dana, U. S. Ex. Exp. Crust., p. 322, Pl. XIX, f. 8 (1852); Heller, Reise Novara, Crust., p. 42 (1867); Smith, Trans. Conn. Acad., ii, p. 135 (1870; Streets, Proc. Phila. Acad., 1872, p. 240. *Monolepis inermis* Say, l. c., p. 157 (Megalops).

Carapax convex, granulate above, front but little deflexed; lateral angles of carapax acute, extending as far forward as the middle of the front. Lateral margin crenulate, arcuate, the carapax being widest at the anterior third. Orbits below with spiniform tubercles and occasionally a distinct emargination. Eyes with the extremities rounded and not reaching to the extremity of the orbit. Chelipeds with spines and tubercles; the meros with the upper and lower margins spined, the posterior rounded and crossed by tubercular rugæ. Carpus with the tubercles obsolete above but pronounced near the margins, the inner margin armed with one or more strong spiniform teeth. Hands tuberculate, the upper margin spined, the lower serrate. A tubercular stridulating ridge on the inside near the fingers. Fingers strongly inflexed. Ambulatory feet compressed, hairy, their sides smooth, the upper portion margined and crossed by transverse rugæ.

* There were at least two editions of Catesby published, bearing dates respectively as above and as the second is post-Linnean, the names employed by him must hold. I think that another edition exists in the library of the Essex Institute at Salem, Mass., the date of which is between those quoted above, but I have nothing at hand by which to decide the matter.

Young specimens (less than 10 mm. broad) have the lateral angle further back than in the adult, while the spines of the chelipeds are wanting or but faintly indicated.

The *O. albicans* of Bosc, Lamarck and Desmarest has the eyes terminated by a style, a feature I have never observed in any specimen of *O. arenaria*. The locality given is South Carolina. The *O. rhombea* of Fabricius is *not* this species, as his expression "*Carpus utrinque unidentatis, manibus sublaevis*" will not apply to this form, but agrees better with *O. cordimana*. Fabricius gives no locality for his specimens. The Brazilian forms (*rhombea* Auct.) show no differences from northern specimens. I have seen specimens from over thirty localities embraced in the limits of Great Egg Harbor, N. J. (Say's types), to Rio Janeiro, Brazil, and also specimens from the west coast of Mexico (Dr. W. H. Jones).

10. *O. convexus* Quoy and Gaimard.

Ocypoda convexus Quoy et Gaimard, Voy. Uranie, Zool., iii, p. 525, Pl. LXXVII, f. 2 (1828); Edw., Hist. Crust., ii, p. 49 (1837).

Carapax granulate, sides arcuate, front deflexed, orbits sinuate, lateral angles behind the base of the rostrum, acute. Meros internally entire, distally tuberculate; carpus tuberculate, its inner surface with a bifid tubercle. Hands cordate, externally granulate, serrate above and below.

This brief description is taken from the figure of MM. Quoy and Gaimard. I have never seen the species. It is said to have come from Australia.

11. *O. cordimana* Desm.

? *Ocypoda rhombea* Fabr., Suppl. Ent. Syst., p. 348 (1798). *Ocypoda cordimana* Desm., Consid. sur les Crustacés, p. 121 (1825); Edw., Hist. Nat. Crust., ii, p. 45 (1837); Ann. Sci. Nat. III, xviii, p. 143 (1852); Jacquinot et Lucas, Voy. Astrolabe et Zelee, p. 64; Heller, Reise Novara Crust., p. 42 (1867); A. M. Edw., Nouv. Arch. Mus., ix, p. 271 (1872). *Ocypoda rhombea*? Desmarest, l. c., p. 122; Randall, Jour. Phila. Acad., viii, p. 123. *Ocypoda pallidula* Jacquinot et Lucas, l. c., Pl. VI. f. 4. *Ocypoda laevis* Dana, U. S. Expl. Exped., Crust., p. 325, Pl. XX, f. 2 (1852). ? *Ocypoda convexa* Stm., Proc. Phila. Acad., 1858, p. 100.

Carapax arcuate, evenly granulate. Front strongly deflexed. Orbits sinuate above; lateral angles acute, but not extending as far forward as the base of the front. Sides in the adult slightly

arcuate, but in the young they are parallel or even concave, converging behind. Eyes, without styliform process, and extending nearly or quite to the orbital angle. Meros of chelipeds with its anterior margin crenulate in the young, in the adult with spiniform tubercles. Carpus externally granulate. Hand short, broad, cordate, granulate internally and externally, its lower margin serrate, the stridulating ridge nearly obsolete. Fingers short, compressed, the thumb slightly hooked at the extremity. Meral joints of the ambulatory feet with transverse rugæ. Carpal and propodal joints similarly roughened and covered with a short pubescence.

New Zealand! *Mauritius!* (Guerin); *Australia!* (E. Wilson); *Sandwich Is.!* (J. K. Townsend); *Tahiti!* (A. Garrett); *Mozambique* and *Zanzibar* (Hilgendorf); *Red Sea*, *Manilla*, *Nicobars* (Heller); *Hong Kong*, *Loo Choo* (Stm.); *Japan* (Edw.).

The following are not true members of the genus :

<i>O. angulatus</i> Latr.	= <i>Gonoplax angulatus</i> .
<i>O. aurantia</i> Bosc. ex Herbst	= <i>Thelphusa aurantia</i> .
<i>O. carnifex</i> Latr. ex Herbst	= <i>Cardiosoma carnifex</i> .
<i>O. heterochelos</i> Bosc.	= <i>Gelasimus heterochelos</i> .
<i>O. hispana</i> Bosc. ex Herbst	= <i>Sesarma</i> sp.
<i>O. hydrodromus</i> Latr. ex Herbst	= <i>Thelphusa hydrodromus</i> .
<i>O. longimana</i> Latr.	= <i>Gonoplax rhomboidalis</i> .
<i>O. maracoani</i> Latr.	= <i>Gelasimus maracoani</i> .
<i>O. macrocheles</i> Bosc.	= ? <i>Macrophthalmus</i> sp.
<i>O. pugillator</i> Bosc.	= <i>Gelasimus pugillator</i> .
<i>O. quadrata</i> Bosc.	= <i>Sesama</i> sp.
<i>O. rufopunctata</i> Latr. ex Herbst	= <i>Trapezia rufopunctata</i> .
<i>O. senex</i> Latr. ex Fabr	= <i>Thelphusa</i> sp.
<i>O. tetragonon</i> Bosc. ex Herbst	= <i>Gelasimus tetragonon</i> .
<i>O. tridens</i> Latr. ex Fabr.	= ? <i>Pachygrapsus</i> sp.
<i>O. vocans</i> Latr.	= <i>Gelasimus</i> sp.

I have not been able to identify

O. granulata Bosc. (Edit. ii) p. 247.

O. macleayana Hess, Archiv. für Naturgesch., XXXI, p. 143, Pl. VI, f. 8 (1865). Australia.

O. unispinosa Rafinesque, Precis de découvertes Semiologiques, p. 21, No. 35 (1814).

CARCINOLOGICAL NOTES, No. IV.—SYNOPSIS OF THE GRAPSIDÆ,

BY J. S. KINGSLEY.

The following paper is a continuation of my studies of the Catometopa contained in the Museum of the Academy of Natural Sciences of Philadelphia. In it I have endeavored to embrace every known species of the family with sufficient references to their geographical distribution. To aid in the identifications of species I have compiled analytical tables for most of the genera, but descriptions are given of only those species of which I have examined specimens. I have reduced considerably the number of nominal species, but believe that I am fully warranted in relegating to synonymy many so-called species founded on size, color, geographical distribution, or variations of minor importance. All localities from which I have examined specimens are marked with an exclamation point (!). The classification employed is mainly that of Dana, in the U. S. Exploring Expedition Crustacea (1852); those of Milne-Edwards (Annales des Sciences Naturelles, III Series, Zoologie, tome xx, pp. 163-200, 1853), and Kossmann (Zoologische Ergebnisse, Reise in die Küstengebiete des rothen Meeres, 1877), being comparatively worthless. Owing to the limited amount of space at my disposal, the synonymy and bibliography have been condensed as far as possible.

Family GRAPSIDÆ Dana. (*Grapsoidiens* M. Edw.).

Carapax subquadrate, depressed. Front generally broad. Eyes short. Antennulæ transversely plicate. Epistome short, sometimes linear. Meros of the external maxillipeds bearing the palpus at the summit or at its external angle. Second joint of the abdomen of the male nearly as wide as the adjacent portion of the sternum.

The *Grapsidæ* are all inhabitants of the temperate or tropical waters, and generally live near the shores. A few, however (e.g. *Nautilograpsus* and *Varuna*), live on the high seas. The family may conveniently be divided into two¹ sub-families, by characters derived from the antennæ. In the *Grapsinæ* the antennæ are

¹ The characters given by Dana for the Sesarminæ I do not consider of sufficient importance to warrant its retention as a sub family, and would rather consider it as a group of the Grapsinæ.

covered by the front; in the *Plagusinæ* they are received into notches in the front and are visible from above.

Analytical Key to the Genera of the Grapsidæ.

- Antennæ covered by the front. GRAPSINÆ.
 External maxillipeds without a piliferous ridge. GRAPSINI.
 External maxillipeds widely gaping.
 Antennæ excluded from the orbit.
 Meros of the external maxillipeds as long as the ischium. *Goniopsis*.
 Meros of the external maxillipeds shorter than the ischium. *Metopograpsus*.
 Antennæ entering the orbit.
 Front less than half the width of the carapax.
 No tooth behind the orbital angle. *Epigrapsus*.
 One tooth behind the orbital angle.
 Fingers of cheliped excavate. *Grapsus*.
 Fingers acuminate.
 Sides straight. *Orthograpsus*.
 Sides arcuate in front. *Geograpsus*.
 Two teeth behind the orbital angle. *Leptograpsus*.
 More than two teeth behind the angle of the orbit.
 Male abdomen five-jointed, antennulæ transverse, front straight. *Grapsodes*.
 Male abdomen seven-jointed, antennulæ oblique, front excavate. *Cyrtograpsus*.
 Front more than half the width of the carapax.
 Carapax transverse. *Pachygrapsus*.
 Carapax longer than broad. *Nautilograpsus*.
 External maxillipeds without a rhomboidal gape.
 Palpus articulating with the inner angle of the meros of the external maxillipeds.
 One tooth behind the orbital angle. *Brachygrapsus*.
 Several teeth behind the orbital angle. *Euchirograpsus*.
 Palpus articulating with middle of the anterior margin of the meros of the external maxillipeds.
 Exognath of external maxillipeds very broad. *Ptychognathus*.
 Exognath much narrower than the ischium.
 Sides of carapax entire. *Acmæopleura*.
 Sides of carapax dentate.
 External distal angle of the meros of the external maxillipeds expanded.
 Joints of ambulatory feet rounded, dactyli styliform. *Pseudograpsus*.
 Ambulatory feet compressed, dactyli flattened, natatorial. *Varuna*.
 Meros of external maxillipeds not expanded.

- Meros of external maxillipeds broader than long.
 Meros as long as ischium. *Glyptograpsus*.
 Meros shorter than ischium. *Utica*.
 Meros as long or longer than broad.
 Front nearly half as wide as carapax. *Heterograpsus*.
 Front not over one-third as wide as carapax. *Eriocheir*.
 Palpus articulating with the outer angle of the meros of the external maxilliped.
 One tooth behind the orbital angle. *Perigrapsus*.
 More than one tooth behind the orbital angle. *Platygrapsus*.
 External maxillipeds with an oblique piliferous ridge. **SESARMINI**.
 Meros of external maxilliped elongate, its apex rounded.
 Antennæ excluded from the orbit. *Metasesarma*.
 Antennæ not excluded from the orbit.
 Carapax subquadrate, sides arcuate.
 Joints of ambulatory feet entire. *Sarmatium*.
 Joints of ambulatory feet dentate. *Rhaconotus*.
 Carapax quadrate, sides straight. *Sesarma*.
 Carapax elongate, narrowed behind. *Aratus*.
 Meros of external maxilliped short; its distal border truncate or even excavate, and bearing the palpus.
 Antennæ excluded from the orbit. *Chistoceloma*.
 Antennæ entering the orbit.
 Sides of carapax straight. *Helice*.
 Sides arcuate.
 Sides entire. *Cyclograpsus*.
 Sides emarginate or toothed. *Chasmagnathus*.
 Antennæ lodged in notches in the front, and visible from above.
PLAGUSINÆ.
 Meros of external maxillipeds large, as broad as ischium. *Plagusia*.
 Meros small and much narrower than ischium. *Leiolophus*.

Sub-family **Grapsinæ** (*Grapsinæ* et *Sesarminæ* Dana).

Antennulæ more or less transverse, and covered by the front.

Tribe **GRAPSINI** (Sub-family *Grapsinæ* Dana).

§ External maxillipeds without an oblique piliferous ridge on the ischial and meral joints.

Genus **GONIOPSIS** De Haan, 1835 (*Goniograpsus* (pars) Dana, 1851).

Carapax flat; front vertical, over half as wide as carapax; sides straight, one-toothed. Suborbital lobe broad, reaching the front and excluding the antenna from the orbit. External maxillipeds slender; meral and ischial joints of equal length.

11. *G. cruentatus* De Hann ex Latreille.

Cancer ruficola De Geer. Memoirs pour servir a l'Hist. Insectes, vii, 417, Pl. XXV, 1778 (non Linné).

Grapsus cruentatus Latreille. Histoire Naturelle des Crust. et Ins., vi, p. 70 (1803-4).

Goniopsis cruentatus De Haan. Fauna Japonica Crust., p. 33 (1835).

Grapsus longipes Randall. Jour. Phila. Acad., viii, p. 125 (1839).

Goniopsis ruficola White. List Brit. Mus. Crust., p. 40 (1847).

Grapsus pelli Herklots. Additamenta ad Faunam Carcinologicam Africae Occidentalis, 8, Pl. I, f. 6-7 (1851).

Goniograpsus cruentatus Dana. U. S. Expl. Exped. Crust., p. 342, Pl. XXI, f. 7 (1852).

Front granulate, supra-frontal lobes four, margins crenulate, orbits entire above, distally emarginate. Carapax with oblique transverse ridges. Anterior margin of meros of chelipeds expanded, dentate, the upper and lower margins with spiniform tubercles, as is also the upper margin of carpus. Hands with spiniform tubercles above and below, the middle of the outer surface smooth, the inner surface with scattered prominent granules. Thumb and finger sub-excavate, the latter spinose above. Ambulatory feet compressed and armed with stiff black bristles. Posterior angle of meros of last pair rounded, in the other feet dentate.

Florida! (H. E. Webster, in Union College Museum); *Bahamas!* *Cuba!* (H. F. Baker); *Surinam!* (Dr. Hering, Randall's type of *G. longipes*); *Gaboon, W. Africa* (Du Chaillu); *West Coast of Nicaragua!* (J. A. McNeil, in Museum of Peabody Academy); *Tropical Seas of America* (Auct.).

Genus **METOPOGRAPSUS** M.-Edw., 1853.

Front more than half the width of carapax, deflexed. Sides straight. Internal suborbital lobe very broad, reaching the front and excluding the antenna from the orbit. Meros of external maxilliped short, much broader than long.

Key to Species.

Antero-lateral margin entire.

Frontal margin sinuate.

Frontal margin straight.

Antero-lateral margin toothed.

messor.
latifrons.
oceanicus.

M. messor Edwards ex Forskal.

Cancer messor Forskal. Descr. An. in Itin. Observ., p. 88 (1775).

Grapsus gaimardii Andouin, Expl. Pl. Savigny (teste Edw.).

Grapsus messor Edw. Hist. Nat. Crust., ii, p. 88 (1837).

Grapsus thukuhar Owen. In Beechey's Voyage, Zoology, p. 80, Pl. XXIV, f. 3 (1839).

Grapsus parallelus Randall. Jour. Acad. Nat. Sci., Phila. viii, p. 127 (1839).

Metopograpsus messor, thukuhar, eydouxi et intermedius Edw. Ann. Sci. Nat., III, xx, p. 165 (1853).

Carapax slightly narrowed behind, plications and rugæ more or less distinct. Frontal lobes rather prominent, frontal margin sinuate, smooth or crenulate at the angles. Meros of chelipeds with the posterior surface rugose, the anterior margin expanded and distally truncate, a few spinose teeth near the base and several on the truncate margin. Carpus externally rugose, internally with a prominent bifid or quadrifid tubercle. Hands with oblique folds above and below, and a longitudinal ridge on the lower outer surface. Fingers sub-excavate. Last joint of male abdomen but slightly narrower than penult joint.

Sandwich Is. ! (Nuttall, Pease, Jones, Wilkes' Expedition); *Tahiti !* (A. J. Garrett); *Australia !* (E. Wilson); *Mauritius !* (Guerin); *Aden ; ! Natal !* (Dr. T. B. Wilson); *Indian and Pacific Oceans* (Auct.)

M. latifrons Edwards ex White.

Grapsus latifrons White, in Jukes' Voyage of the Fly, ii, p. 337, Pl. II, f. 2 (1847).

Metopograpsus latifrons et maculatus Edw., Ann. Sci. Nat. III, xx, pp. 166 and 165, Pl. VII, f. 1 (1853).

Metopograpsus pictus A. M.-Edw., Ann. Soc. Ent. France, vii, p. 283 (1867); Nouv. Arch. du Mus., ix, p. 289. Pl. XIII, f. 2 (1873).

Carapax narrowed behind, plications indistinct; frontal lobes granulate on the edge. Front broad, nearly straight, margin denticulate. Chelipeds similar to those of *M. messor*. Base of last joint of male abdomen much narrower than the extremity of penult joint.

Batavia ! (Dr. Wilson); *Singapore* (White); *Java* (Edw); *New Caledonia* (A. M.-Edw.).

M. oceanicus Jacq. et Lucas.

Metopograpsus (Grapsus) oceanicus Jacquinot et Lucas, Voyage Astrolabe et Zélee, Crust., p. 73, Pl. VI, f. 9 (Text 1853, Plates 1842-53).

Metopograpsus quadridentatus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 102.

Pulo Han (J. et L.); *near Hong Kong* (Stm.); *Nicobar Is.* (Heller).

Genus **EPIGRAPSUS** Heller, 1862¹ (*Nectograpsus* Heller, 1865).

Sides arcuate, entire orbits externally open; external maxillipeds gaping, meros shorter than the ischium, rather broad abdomen of the male five-, of the female seven-jointed.

E. politus Heller.

Epigrapsus politus Heller, Verh. Z. B. Ges. Wien, 1862, p. 522.

Nectograpsus politus Heller, Reise der Novara, Crustaceen, p. 57, Pl. V, f. 3 (1865).

Nicobars; *Tahiti* (Heller).

Genus **GRAPSUS** Lamarek (restrict).

Sides arcuate, with one tooth behind the orbital angle; front narrow, deflexed; antennæ entering the orbit. External maxillipeds slender, gaping; meros oblong. Fingers of chelipeds excavate.

G. maculatus Edwards ex Catesby.

Pagurus maculatus Catesby, Nat. Hist. of the Carolinas, ii, Plate XXXVI, f. 1 (1743 et 1771).²

¹ Dr. Heller, in his preliminary account of the Crustacea collected by the Novara Expedition (Verhandl. Zool. Bot. Gesellschaft, Wien, 1862, pp. 519-528), characterizes several genera and species of which no mention is made in the final report. These are *Menathius brevirostris* which is probably *Acanthonyx consobrinus* A. Edw., of the final report; *Xantho tetraodon* is *Eudora tetraodon*, *Carpilodes granulatus* appears to be *C. tristis* Dana. *Iupa hirsuta* was probably referred to *Neptunus sanguinolentus*. *Thelphusa wüllerstorfi* appears to be *I. leschenaudii*, *Parathelphusa dentipes* to be *P. tridentata*, *Helæcius areolatus* to be *H. cordiformis*, *Metaplax hirtipes* is apparently referred to a new genus, *Grapsus depressus* is probably *Geograpsus crinipes*, *Grapsus declivifrons* is apparently rechristened *Pachygrapsus intermedius*, *Heterograpsus barbigerus* has its specific name altered to *barbimanus*, *Epigrapsus* nov. gen. reappears as *Nectograpsus* nov. gen. with no reason assigned for the change. *Metasesarma granulatus* is redescribed as new under the name *rugulosu*. *Plagusetes elatus* is probably, as pointed out by Mr. Miers (Ann. and Mag. Nat. Hist., ix, p. 147, 1878), *Acanthocyclus gayi* of the final report. *Gelasimus variegatus* appears to have been finally referred to *G. annulipes*. *Palinurus paulensis* was afterward apparently referred to *P. lalandii* and *Pelias notatus* is referred to *Anchistia*. All this shuffling of names is made without the slightest hint to aid one in correlating the two papers, and is a proceeding which cannot be too strongly condemned.

² There were at least two editions of Catesby bearing dates as above, and as the second appeared thirteen years after the tenth edition of the *Systema Naturæ* of Linné, and five after the twelfth edition, the names employed by Catesby will hold.

Cancer grapsus Linn., Syst. Nat., Edit., x, p. 630 (1758).

Grapsus pictus Latreille, Hist. Crust. et Ins., vi, p. 69, Pl. XLVII, f. 2 (1803-4.)

Goniopsis pictus De Haan, Fauna Japonica Crust., p. 33 (1835).

Grapsus strigosus Brullé, in Webb et Berthelot Hist. Canaries, ii, Pl. II; Crustacea, p. 15, 1836-44 (teste¹ Edw.)¹

Grapsus maculatus, webbi, ornatus et pharaonis Edw., Ann. Sci. Nat. pp. 167-8, Pl. VI, f. 1 (1853).

Grapsus altifrons Stimpson, Annals N. Y. Lyceum Nat. Hist., vii, p. 230 (1860).

Carapax depressed, transversely plicate, folds anteriorly broken up into squamiform tubercles. Frontal crest four-lobed, median lobes the larger, their margins subtuberculate. Frontal margins crenulate, regularly arcuate. Lateral margin arcuate. Inferior border of orbit with a deep fissure. Anterior border of ischium and meros of cheliped spinose, the lower margin of the meros spinotuberculate, the posterior surface plicate. Carpus with distant tubercles, its interior margin with a laminate spine. Hand above tuberculate, externally with longitudinal ridges, below with oblique folds. On the inner surface the tubercles and folds are less prominent. Fingers short, tips excavate. Ambulatory feet compressed, propodal and dactylic joint spinose.

Florida Keys! (Webster, Ashmead); *West Indies!* (Lawrence, Wood, Wilson, Gôes, Lea); *San Lorenzo!* (Wilkes' Expedition); *Pernambuco!* (Dr. Wilson); *Tahiti!* (A. Garrett); *W. Coast Mexico!* (Dr. Jones); *Central America!* (McNiell); *New Zealand!* (Dr. Wilson); *Mauritius!* (Guerin); *Natal!* (Dr. Wilson); *Georgia, California, Peru, St. Helena and Cape Verde Is.* (Miers); *Paumotu and Hawaiian Is.* (Dana); *Honduras!* (no collector's name).

The genus *Grapsus*, as well as several others, is divided into sections by Milne-Edwards, characterized either by having the posterior distal angle of the meros of the last pair of ambulatory feet regularly rounded, or dentate; but in specimens of *G. maculatus*, I have occasionally found this angle on one side entire, and the other dentate.

G. maculatus var. *tenuicristatus* Martens ex Herbst.

Cancer tenuicristatus Herbst. Krabben und Krebse, Pl. III, f. 33-34, 1790 (teste Martens).

Grapsus rudis Edw., Hist. Nat. Crust., ii, p. 87 (1837).

Grapsus hirtus Randall, Jour. Phila. Acad., viii, p. 124 (1839).

¹ Brullé gives not the slightest description which will distinguish his specimens from either *maculatus* or *strigosus*.

Is distinguished from the typical forms of *G. maculatus* only by the hairy carapax and meral joints of the ambulatory limbs, and the narrower carpal spine. All other characters which have been given prove inconstant. Dr. Martens, by an examination of Herbst's type, has shown the identity of Herbst's *tenuicristatus*, and Edwards' *rudis*:

Hawaian Is.! (J. K. Townsend, Randall's type); *Oahu*! (Dr. W. H. Jones); *Ceylon* (Heller); *Bonin* (Stm.).

***G. strigosus* Latreille ex Herbst.**

Cancer strigosus Herbst, Pl. XLVII, f. 7 (1799).

Grapsus strigosus Latr., Hist. Crust. et Ins., vi, p. 70 (1803-4).

Grapsus albolineatus Lamarck, Hist. Animaux sans Vertebres, v, p. 249 (1817).

Goniopsis strigosus De Haan, Fauna Japonica Crust., p. 33 (1835).

Grapsus granulatus, *peronii* et *pelagicus* Edw., Ann. Sci. Nat., III, xx, p. 169 (1853).

Grapsus longipes et *subquadratus* Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, pp. 102 et 103.

Carapax but little convex, posteriorly with oblique transverse lines, anteriorly with squamiform tubercles. Frontal lobes moderate, frontal margin crenulate. Orbits with a deep fissure below. Epistome short. Meros spined anteriorly, its other margins rounded, the posterior surface with transverse rugæ. Carpus granulate and bearing internally a slender spine. Hands much as in *G. maculatus*. Posterior distal angle of meros of last pair of ambulatory feet denticulate.

Natal! *Australia*! (Dr. T. B. Wilson); *Sandwich Is.*! (in Peabody Acad.). Its distribution is embraced within the above limits and *Hong Kong* (Stimpson).

***G. gracilipes* Milne-Edwards.**

Grapsus gracilipes Edw., Ann. Sci. Nat., III, xx, p. 168 (1853).

China (Edwards).

Subgenus *Orthograpsus*, nov.

Carapax transverse, broadest behind. Sides straight, with one tooth behind the orbital angle. Antennæ entering the orbit. Fingers of chelipeds acute.

***O. hillii* nov.**

Carapax depressed, plications faint. Supra-frontal lobes moderate; front straight, narrow, deflexed. Sides of carapax straight, post-orbital tooth small. Meros of external maxilliped a little

longer than broad. Chelipeds much as in *Metopograpsus messor*, the hand granulate above, fingers acuminate. Posterior distal angle of meral joints of ambulatory feet rounded, entire or finely serrate, there being a variation in the sides of the same specimen.

West Indies! (Dr. Wilson); *Key West, Fla.!* (Dr. A. S. Packard, Jr., Peab. Acad.).

O. longitarsis Kingsley *ex* Dana.

Grapsus longitarsis Dana, Proc. Acad. Nat. Sci., Phila., 1851, p. 249.

U. S. Expl. Exped. Crust., p. 339, Pl. XXI, f. 4 (1852).

Paumotu Archipelago (Dana).

Genus **GEOGRAPSUS** Stimpson, 1858 (*Discoplax*, Am. Ed., 1867).

Carapax depressed, sides curved in front, straight behind, one tooth behind the angle of the orbit. Front narrow, strongly deflexed. Internal suborbital lobe large. Antennæ entering the orbit. Dactyli of chelipeds acuminate.

Synopsis of Species.

Meros of chelipeds with a laminiform expansion of the anterior margin.

Front nearly straight.

Folds of carapax transverse.

lividus.

Folds of carapax oblique.

grayi.

Front arcuate.

crinipes.

Meros not expanded, carapax tuberculate anteriorly.

longipes.

G. lividus Stimpson *ex* Milne-Edwards.

Grapsus lividus Edwards, Hist. Nat. Crust., ii, p. 85 (1837).

Grapsus brevipes Edw., Ann. Sci. Nat., III, xx, p. 170 (1853).

Geograpsus lividus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 101.

Geograpsus occidentalis Stimpson, Annals N. Y. Lyc., vii, p. 230 (1860).

Carapax much broader than long, depressed. Plications nearly transverse. Frontal lobes prominent, front deflexed, its margin nearly straight. Sides of carapax slightly arcuate. Orbit with a deep fissure below. Meros of chelipeds above and below with transverse rugæ, its anterior margin expanded, proximally denticulate, distally the teeth are larger. Carpus granulate and with a short spine on the inner margin. Hand and dactylus tuberculate above, externally and below with short, oblique rugæ; fingers acuminate. Distal angle of meral joints of the last pair of ambulatory feet rounded.

Isle Bartholomew, W. I.! (A. Goës); *Chili!* (Guerin); *West Indies* (Auct.); *Cape St. Lucas* (Stm.).

G. crinipes Stimpson *ex* Dana.

Grapsus crinipes Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 249. U. S. Expl. Exped. Crust., p. 341, Pl. XXI, f. 6 (1852).

Geograpsus crinipes Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 101.

Grapsus depressus Heller, Verh. Z. B. Gess. Wien, 1862, p. 521.

Carapax depressed, the sides nearly parallel, folds of the carapax oblique, frontal lobes but little prominent, front arcuate. Ischial joint of cheliped spined in front; meros with the anterior margins expanded, finely serrate proximally, more coarsely so at the apex; carpus and hand roughened above, a few inconspicuous lines on the lower outer surface of the palm. Distal angle of meros of the last pair of ambulatory feet rounded.

Sandwich Is.! (Dr. W. H. Jones); *Tahiti* (Heller).

G. grayi A. Milne-Edwards *ex* H. Milne-Edwards.

Grapsus grayi Edw., Ann. Sci. Nat., III, xx, p. 170, 1853.

Geograpsus rubidus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 103.

Geograpsus grayi A. M.-Edw., Nouv. Arch. du Mus., ix, p. 288 (1873).

Carapax somewhat inflated, its folds oblique; frontal lobes prominent, front nearly straight. Orbit with a slight fissure below; chelipeds much as in *G. crinipes*. Distal angle of meros of last pair of feet rounded, entire or dentate.

This is probably the adult of the preceding species.

Tahiti! (A. Garrett); *Australia*, *Mauritius*, *Zanzibar* (Hilgendorf); *Madagascar*, *India*, *Bonin*, *New Caledonia* (A. M.-Edw.).

G. longipes Kingsley *ex* A. Milne-Edwards.

Discoplax longipes A. M.-Edw., Ann. Soc. Ent. France, vii, p. 284 (1867). Nouv. Arch. du Mus., ix, p. 294, Pl. XV (1873).

New Caledonia (A. M.-Edw.).

Genus **LEPTOGRAPSUS** M.-Edwards (pars), 1853, Stimpson.

Carapax with the sides arcuate, two-toothed. Front less than half the width of the carapax, not deflexed. Internal sub-orbital lobe small, antennae entering the orbit. Meros of external maxillipeds as broad as long, but shorter than the ischium.

Leptograpsus variegatus Milne-Edwards *ex* Fabricius.

Cancer variegatus Fabr., Ent. Syst., ii, p. 450 (1793).

Grapsus marginatus Latr., Hist. Crust. et Ins., vi, p. 71 (1803-4).

Grapsus personatus Lamarck, Hist. An. sans Vert., v, 249 (1817).

Grapsus pictus Quoy et Gaimard, Voyage Uranie et Physiciene, p. 523, Pl. LXXVI, f. 2 (1824).

Grapsus strigillatus White, in Gray's Zoological Miscellany, p. 78 (1842).

Grapsus variegatus Edwards et Lucas, in d'Orbigny's Voyage, p. 27 (1849).

Grapsus planifrons Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 249. U. S. Expl. Exped. Crust., p. 638, Pl. XXII, f. 3 (1852).

Leptograpsus variegatus Edw., Ann. Sci. Nat., III, xx, p. 171 (1853).

Leptograpsus bertheloti, verreauxi, ansoni et gayi Edw., l. c., p. 172 (1853).

Carapax nearly flat, transversely plicate. Protogastric region concave, with squamose tubercles, protogastric lobes but little prominent. Front slightly depressed, its margin crenulate and nearly straight. Orbits with a narrow, deep, external fissure. Meros of chelipeds with the anterior border expanded, dentate; the other angles rounded, the posterior surface rugose. Carpus tuberculate and with a short spine on the internal surface. Hand tuberculate above, externally smooth. In the young there is an elevated line along the outside of the palm. Ambulatory feet with stiff setæ.

Pernambuco! (Dr. Wilson); *Chili!* (Wilkes' Expedition); *Australia!* (E. Wilson); *New So. Wales!* (Capt. Putnam, Peabody Academy); *Isle Guam* (Quoy and Gaimard); *Canaries* (Edw.); *Norfolk I.* (Miers); *Shanghai* (Heller).

Genus **GRAPSODES** Heller, 1865.

Carapax depressed, sides arcuate and dentate in front, behind straight. Front less than half the width of the carapax, strongly deflexed. Orbits externally open. Internal sub-orbital lobe small, antennæ entering the orbit. Meros of external maxilliped longer than broad. Male abdomen five-jointed.

G. notatus Heller.

Grapsodes notatus Heller, Novara Crust., p. 58, Pl. V, f. 2 (1865).

Nicobars (Heller).

Genus **CYRTOGRAPSUS** Dana, 1851.¹

Carapax broader than long, front narrow, excavate, sides arcuate, with three teeth behind the orbital angle. External maxillipeds widely gaping, without a piliferous ridge. Epistome very

¹ For some reason, Prof. Smith in his paper on Brazilian Crustacea (Transactions of the Connecticut Academy of Arts and Sciences, Vol. ii, pp. 1-42, 1869), and in his notes on Ocypodoidea (l. c., p. 154), refers several times to this genus, and always as *Cryptograpsus*.

short. Antennæ entering the orbit. Male abdomen seven-jointed, the second joint very short.

C. angulatus Dana.

Cyrtograpsus angulatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 250. U. S. Expl. Exped., p. 352, Pl. 22, f. 6 (1852).

Cryptograpsus angulatus Smith, Trans. Conn. Acad., ii, p. 37, 1869.

Carapax uneven, granulate. Sides three-toothed, second tooth small. Orbits with a slight fissure above. Feet all granulate. Hands inflated, fingers acuminate.

Rio Negro, Patagonia! (U. S. Expl. Exped.).

C. cirripes Kingsley ex Smith.

Cryptograpsus cirripes Smith, Trans. Conn. Acad. ii, p. 11, Pl. I, f. 3 (1869).

Carapax depressed, areolate; front narrow, slightly excavate. Sides of carapax strongly arcuate, with four teeth behind the angle of the orbit, the second and last teeth much smaller than the others; all of the borders of the carapax are crenulate. Chelipeds stout, granular. Propodal joints of first, second, and fourth, and dactylus and carpus of fourth pair of ambulatory feet haired.

Rio Janeiro! (Captain Harrington, Peabody Academy of Science, Salem, Mass., types).

Genus **PACHYGRAPSUS** Randall (1839); Stimpson (1858).

Carapax somewhat narrowed behind, and with transverse striæ. Front more than half the width of the carapax, sides entire, or with one or two teeth; inner sub-orbital lobe small, allowing the antennæ to enter the orbit. External maxillipeds widely gaping, meros as broad as long. Type, *P. crassipes*.

Synopsis of Species.

Sides entire.

Front straight or nearly so.

Numerous transverse folds on carapax; lower margin of hand spined.

Carapax but little plicate, hands smooth below.

corrugatus.

Front strongly sinuate.

æthiopicus.

Hands smooth.

minutus.

Hands externally with longitudinal ridges.

plicatus.

Sides with one tooth behind the orbital angle.

Posterior distal angle of meros of fifth pair of feet rounded.

Front with a prominent tooth at angle.

crassipes.

Front slightly sinuate without prominent teeth.

maurus.

Posterior distal angle of meros of fifth feet dentate.

Fingers of cheliped smooth.	<i>transversus</i> .
Fingers dentate or spined above.	<i>gracilis</i> .
Sides two-toothed.	
Transverse lines of carapax naked.	<i>marmoratus</i> .
Transverse lines of carapax haired.	<i>pubescens</i> .
Unknown to me.	<i>latipes</i> .

P. crassipes Randall.

Pachygrapsus crassipes Randall, Jour. Acad. Nat. Sci. Philadelphia, viii, p. 127 (1839).

Grapsus eydouxi Edw., Ann. Sci. Nat., III, xx, p. 170 (1853).

Leptograpsus gonagrus Edw., I, c., p. 173 (1853).

Carapax somewhat arcuate, sides with a single tooth behind the orbital angle; frontal lobes prominent; front deflexed, its margin nearly straight, the angles with a prominent tooth. Meros of chelipeds with the anterior margin produced, distally truncate and dentate. Hands inflated, margined above and with a longitudinal ridge on the lower outer surface; fingers excavate. Distal angle of meros of posterior ambulatory feet rounded; dactyli of the ambulatory feet spinulose.

(?) *Sandwich Is.*! (T. Nuttall, Randall's type); *California* from *San Francisco!* to *San Diego!* (Many collectors); ? *New Providence*, *W. I.*! (H. C. Wood, Jr.); *Yokohama* (Tozzetti).

P. maurus Lucas.

Pachygrapsus maurus Lucas, Expl. Algiers, Crust., p. 20, Pl. II, f. 5 (1849).

Goniograpsus simplex Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249; U. S. Expl. Exped. Crust. p. 344, Pl. XXXI, f. 8 (1852).

Pachygrapsus simplex Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 102.

Algiers (Lucas); *Madeira* (Dana); *Rio Janeiro* (Dana, Heller).

P. transversus Gibbes.

Pachygrapsus transversus Gibbes, Proc. Am. Assoc. Adv. Science, iii, p. 182 (1850).

Goniograpsus innotatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249; U. S. Expl. Exped. Crust., p. 345, Pl. XXI, f. 9 (1852).

Leptograpsus rugulosus Edw., Ann. Sci. Nat. III, xx, p. 172 (1853).

Pachygrapsus levimanus Stimpson, Proc. Phila. Acad., 1858, p. 102.

Metopograpsus dubius et miniatus, Saussure, Mem. Soc. Phys. et d'Hist. Nat. Geneve, xiv, pp. 444-445, Pl. II, f. 16, 17 (1858).

Grapsus declivifrons Heller, Verhandl. Z. B. Gesellschaft, Wien, 1862, p. 521.

Pachygrapsus intermedius Heller, Novara Crust, p. 44 (1865).

Pachygrapsus socius Stm., Ann. N. Y. Lyc. x, p. 114 (1871).

Pachygrapsus advena Catta. Ann. Sci. Nat. VI, iii, No. 1. p. 7, Pl. I (1876).

Carapax depressed, shining, with transverse plicæ, oblique on the branchial region. Sides generally slightly arcuate, with one tooth behind the orbital angle. Frontal lobes prominent, front sinuate. Meros of chelipeds with transverse rugæ, the inner margin dentate; carpus rugose, with an internal rounded tubercle. Hand minutely granulate, a longitudinal ridge on the lower outer surface, margins rounded; dactylus with the upper margin smooth. Postero-distal angle of the meros of last pair of ambulatory feet dentate.

Florida! (A. S. Packard; Peab. Acad.; Brown Univ.; H. E. Webster, Union College); *West Indies!* (S. G. Morton, H. C. Wood, Jr.); *Brazil!* (Dr. T. B. Wilson); *California!* (J. L. Leconte); *New Zealand!* (E. Wilson); *Tahiti* (A. Garrett); *W. Coast Nicaragua!* (J. A. McNeil, Peab. Acad.); *Australia* (Stm.); *Rio Janeiro* (Heller); *Madeira* (Stm.).

P. gracilis Stimpson ex Saussure.

Metopograpsus gracilis Saussure, l. c., p. 443, Pl. II, f. 15 (1858)

Grapsus guadulpensis Desbonne et Schramm, Crustaces de la Guadeloupe, p. 48 (1867).

Pachygrapsus gracilis Stimpson, Ann. N. Y. Lyc., x, p. 113 (1871).

Grapsus (*Leptograpsus*) *rugulosus* Martens, Archiv für Naturgeschichte, xxxviii, p. 102 (1872).

Carapax much as in *P. transversus*, but with no folds on the cardiac region; lateral margins nearly straight, one-toothed. Frontal lobes nearly obsolete; front nearly horizontal, regularly arcuate and minutely crenulate. Chelipeds and ambulatory feet nearly as in *P. transversus*, the hand and dactylus, however, being spined or toothed above.

Florida! (A. S. Packard, Jr., Peab. Acad.); *West Indies* (Auct.).

P. corrugatus Kingsley ex Martens.

Grapsus (*Leptograpsus*) *corrugatus* Martens, l. c., p. 107, Pl. IV, f. 8 (1872).

Cuba (Martens).

P. æthiopicus Hilgendorf.

Grapsus (*Pachygrapsus*) *æthiopicus* Hilgendorf, in von der Decken's Reisen in Ost-Afrika, Crust., p. 88, Pl. IV, f. 2 (1869).

Ugurunga, East Africa (Hilgendorf).

P. plicatus Stimpson ex Milne-Edwards.

Grapsus plicatus Edwards, Hist. Nat. Crust., ii, p. 89 (1837).

Grapsus kraussii Edwards, Ann. Sci. Nat. III, xx, p. 170 (1853).

Pachygrapsus plicatus Stimpson, Proc. Acad. Nat. Sci. Phila., p. 102 (1858).

Pachygrapsus striatus A. M.-Edw., Journal Museum Godeffroy, iv, p. 82 (1873).

Carapax broader than long, everywhere crossed by plications which are bordered by short hairs; frontal lobes prominent, front sinuate. Sides of carapax entire. Meros and carpus of chelipeds externally plicate, inner margin of meros expanded, proximally denticulate distally with spiniform teeth. Carpus with a prominent internal spine. Hand and dactylus granulate above, externally the hand bears several longitudinal rugæ. Fingers short, gaping, extremities excavate.

Oahu! (Dr. W. H. Jones); *Tahiti!* (A. Garrett, Peab. Acad.); *New Caledonia*; *Samoan Is.* (A. M.-Edw.); *Natal* (Krauss); *Loo Choo* (Stimpson).

P. marmoratus Stimpson ex Fabricius.

Cancer marmoratus Fabricius, Ent. Syst., ii, p. 450 (1793).

Grapsus varius Latreille, Hist. Crust. et Ins. vi, p. 69 (1803-4).

Grapsus marmoratus Desmarest, Considerations, p. 131 (1825).

Leptograpsus marmoratus Edw., Ann. Sci. Nat. III, xx, p. 171 (1853).

Pachygrapsus marmoratus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 102.

Carapax depressed, naked, transversely plicate; frontal lobes prominent, front depressed, slightly arcuate, or sometimes a little sinuate. Sides with two teeth behind the angle of the orbit. Meros of chelipeds expanded in front, expansion distally truncate and dentate. Carpus and hand tuberculate above, the former with a prominent internal tooth. Fingers slightly excavate. Posterior distal angle of meros of last pair of feet rounded, entire.

France! (Guerin); *Bosphorus!* (Smithsonian); *Mediterranean* (Auct.); *Madeira* (Stm.).

P. pubescens Heller.

Pachygrapsus pubescens Heller, Novara Crust, p. 45, Pl. IV, f. 4 (1865).

Chili (Heller).

P. minutus A. M.-Edwards.

Pachygrapsus minutus A. M.-Edw., Nouv. Arch. du Mus., ix, p. 292, Pl. XIV, f. 2 (1873).

New Caledonia (A. M.-Edw.).

P. simplex Kingsley ex Herklots.

Grapsus simplex Herklots, Additamenta, etc., p. 9, Pl. I, f. 8 (1851).

Boutry, West Coast of Africa (Herklots).

Genus **NAUTILOGRAPUS** Edwards (*Planes* Bell¹).

Carapax narrow, regularly arcuate, sides slightly convex, and bearing a rudimentary tooth behind the orbital angle. Front

¹ The genus *Planes* is a MS. one of Leach. Bowdich, in his "Excursion to Madeira and Porto Santo," p. 15, f. 2 (1825), figures and mentions a spe-

more than half the width of the carapax. External maxillipeds broad, meros broader than long. Posterior feet compressed.

N. minutus Edwards ex Linné.

Cancer minutus Linné Syst. Nat. Edit. xii, p. 1048 (1766).

Grapsus minutus Latreille, Hist. Crust. et Ins., vi, p. 68 (1803-4).

Grapsus cinereus Say, Journ. Acad. Nat. Sci. Phila. i, p. 99 (1817).

Grapsus pelagicus Say, l. c., p. 442 (1818).

Planes clypeatus Bowdich, l. c., p. 15, Pl. f. 2 (1825).

Grapsus testudineum et *pelagicus* Roux, Crust. Med., Pl. VI, f. 6-7 (1828-30).

Ocypoda (*Grapsus*) *pusillus* De Haan, op. cit., p. 59, Pl. XVI, f. 2 (1835).

Nautilograpsus minutus Edw., Hist. Nat. Crust. ii, p. 90 (1837).

Grapsus divis Costa, Fauna Napoli, Crustacea, Pl. IV, f. 1 (1838-1851).

Planes minutus White, Cat. Brit. Mus. Crust. p. 42 (1847)

Nautilograpsus Major et *Smithii*, McLeay in Smith Zool., South Africa, Annulosa, pp. 66-67 (1849).

Planes linneana Bell, British Stalk-eyed Crustacea, p. 135 (1851).

Planes cyaneus Dana, Proc. Phil. Acad., 1851, p. 250.

Nautilograpsus angustatus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 103.

Carapax smooth, arcuate in both directions; front nearly straight, post-orbital tooth small, sometimes obsolete. Sides arcuate. Meros of chelipeds with its inner distal border dentate; Carpus with a tubercle on the inner surface; hand smooth, fingers deflexed. Ambulatory feet compressed, ciliate.

Gulf Stream! (Many Collectors); *West Indies!* (Dr. Griffith); *Surinam!* (Dr. Hering); *Falkland Is.!* (Dr. Wilson); *Peru!* (Dr. Ruschenberger); *West Coast of Mexico!* *Alaska!* (Dr. W. H. Jones); *China!* (Capt. Putnam); *New Zealand!* *Natal!* (Dr. Wilson); *Rio Gambia!* (J. Cassin); *Mediterranean* (Dr. Wilson); *France!* (Guerin); "*toutes des mers!*" (Guerin). Guerin's ideas of the distribution leave nothing more to be said.

Genus **EUCHIROGRAPSUS** M.-Edwards, 1853.

Carapax depressed, subquadrate, sides slightly arcuate, with three teeth behind the orbital angle; orbits entire. Antennæ long,

cies in these words: "A small crab, f. 3, *a* and *b*, which I conceive to be a new species of *Planes* was found in great numbers amongst the anatiferae." In a foot-note the species is described as follows: "It was of a delicate, but bright, rose-color; from the symmetrical form of its test (notched so regularly as to increase the projection and distinctness of its chaperon), it may be called *P. clypeatus*." This can hardly be considered as a sufficient description to establish the genus, and hence I prefer to retain the commonly accepted name.

entering the orbit; Meros of the external maxillipeds about half the length of the ischium, its outer distal angle rounded, its inner excavate and bearing the palpas.

E. liguricus Edwards.

Euchirograpsus liguricus Edwards, Archives du Museum, vii, p. 153, Pl. X, f. 2 (1853).

Nice (Edwards).

Genus **BRACHYGRAPSUS** nov.

Carapax broader than long, arcuate, without transverse lineation, sides nearly straight, with one tooth behind the angle of the orbit. Meros of the external maxillipeds shorter than broad, its external distal angle prominent, the internal one bearing the palpus.¹

B. lævis nov.

Front straight, external angles of orbit not prominent, tooth of lateral margin spiniform. Meros of cheliped triquetral, bearing an obtuse tooth on the upper border. Carpus with an acute internal spine. Hands inflated, smooth; fingers acute. Ambulatory feet elongate, slender, but slightly compressed, the dactyli longer than the propodal joints.

New Zealand! (E. Wilson).

Genus **PTYCHOGNATHUS** Stimpson, 1858 (*Gnathograpsus* A. M.-Edwards).

Carapax flat, lateral border emarginate. External maxillipeds very broad, nearly meeting, the exognath fully as broad as the ischium. The carpus bears the palpus at the middle of the anterior margin, and has the external distal angle strongly produced.

Synopsis of Species.

Exognath of external maxilliped extending to or exceeding the external distal angle of the meros. *riedelii.*

Exognath extending only to the middle of the meros.

Oblique portion of branchial ridge bounded by a granulated ridge.

pilipes.

Oblique portion without a prominent boundary.

pusillus.

Insufficiently characterized.

glaber.

P. glaber Stimpson.

Ptychognathus glaber Stimpson. Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Bonin I. (Stm.)

¹ I am not certain as to the exact position of this genus, as it appears to combine the characters of both the *Cyclometopa* and *Catometopa*. In the form of carapax and structure of the external maxillipeds it closely resembles *Trapezia*. In the male genital appendages it is allied to the *Grapsidae*, where for the present I prefer to allow it to remain.

Dr. Stimpson's short diagnosis presents no characters which are not held in common by both *P. riedelii* and *pilipes*, excepting the non-pilose hand, which in other species of the genus is only of sexual importance.

P. riedelii Kingsley ex A. Milne-Edwards.

Gnathograpsus riedelii A. M.-Edw., Nouv. Arch. du Museum, iv, p. 182, Pl. XXVII, f. 1-5 (1868).

Celebes (A. M.-Edw.).

P. pusillus Heller.

Ptychognathus pusillus Heller, Riese der Novara Crustaceen, p. 60, 1867.

Gnathograpsus barbatus A. M.-Edw., Nouv. Arch. du Museum, ix, p. 316, Pl. XVII, f. 4, 1872.

Carapax depressed, nearly smooth, with a few shallow impressions anteriorly. Front slightly sinuate. Antero-lateral margin with two indistinct teeth behind the orbital angle. Chelipeds finely granulate, but without spines or tubercles. Hands of the male with a lanose spot on the outside at the base of the fingers; in the female this is wanting. The exognath of the external maxillipeds reaches only to the middle of the meros. Ambulatory feet slender, compressed.

Mauritius! (Guerin¹); *Nicobars* (Heller); *New Caledonia* (A. M.-Edw.)

P. pilipes Kingsley ex A. Milne-Edwards.

Gnathograpsus pilipes A. M.-Edw., Nouv. Arch. du Museum, iv, 184, Pl. XXVII, f. 6-10 (1868).

This species is scarcely more than a variety of *P. pusillus*, but I prefer for the present to leave them separate.

Philippines and *Celebes* (A. M.-Edw.).

Genus **ACMÆOPLEURA** Stimpson, 1858.

Carapax depressed, the antero-lateral margins entire. External maxillipeds nearly meeting the meros, bearing the palpus on the middle of the anterior margin; the exognath narrow.

A. parvula Stimpson.

Acmaeopleura parvula Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 105.

Japan (Stimpson).

Genus **PSEUDOGRAPUS** M. Edwards (1837), *restr.*

Carapax depressed, transverse; sides arcuate, with two teeth behind the orbital angle. Front less than half the width of the

¹ These were labeled by Guerin "*Sesarma penicillata* sp. ined."

carapax. Meros of external maxillipeds broader than long, shorter than the ischium and with its external distal angle strongly produced.

Synopsis of Species.

Hands inflated without elevated lines.

Fingers with many long hairs, carapax inflated. *setosus.*

Hairs on the hand between the bases of the fingers short, carapax flat. *albus.*

Hands with an elevated line on the lower outer surface, fingers without hairs. *crassus.*

P. setosus.

Cancer barbatus Rumph., Pl. X, No. 2 (1705).

Cancer setosus Fabricius, Suppl. Ent. Syst., p. 339 (1798).

Grapsus penicilliger Latr., Reg. An. (I Edit.), iii, p. 16, Pl. XII, f. 1 (1817).

Eriocheir? penicilliger De Haan, Fauna Japonica, Crust., p. 31 (1835).

Pseudograpsus penicilliger Edw., Hist. Crust., ii, p. 82 (1837).

Pseudograpsus barbatus Edw., Ann. Sci. Nat., III, xx, p. 191 (1853).
Eastern Seas (Auct).

P. albus Stimpson.

Pseudograpsus albus Stimpson, Proc. Acad. Nat. Sci., Phila., 1858, p. 104.

Japan (Stimpson); *New Caledonia* (A. M.-Edwards).

P. crassus A. Milne-Edwards.

Pseudograpsus crassus A. M.-Edw., Nouv. Arch. du Mus., iv, p. 176, Pl. XXVI, f. 6-10 (1868).

Celebes (A. M.-Edw.).

Genus **VARUNA** Edwards, 1830 (*Trichopus* De Haan, 1835).

Carapax depressed, sides arcuate, two-toothed. Antennulæ oblique. Antennæ entering the orbit; external maxillipeds slightly gaping. Meros much shorter than the ischium, its external distal angle expanded. Palpus articulating with the middle of the anterior margin. Exognath half as wide as ischium. Ambulatory feet compressed, natatorial.

V. litterata Milne-Edwards ex Fabricius.

Cancer litterata Fabr., Suppl. Ent. Syst., p. 342 (1798).

Trichopus litterata De Haan, Fauna Japonica, Crust., p. 32 (1835).

Varuna litterata Edw., Dict. Class. d'Hist. Nat., xvi, p. 511 (1830).
Hist. Nat. Crust., ii, p. 95 (1837).

Carapax smooth, cardiac region partly circumscribed. Front straight, orbits fissured above, lateral teeth separated by slight fissures. Posterior margin of meros of chelipeds acute, the

inferior granulate, the anterior with spiniform tubercles. Carpus with a prominent internal spine and one or two smaller ones. Hands inflated, rough, an elevated line on the lower outer margin. Ambulatory feet strongly compressed, margins ciliate. In a specimen from New Zealand the carpal spines are wanting.

Philippines! (E. & T. B. Wilson); *Indian Ocean!* (Guerin); *New Zealand!* (E. Wilson); *China!* (Capt. Putnam, Peab. Acad.); *Penang!* (J. P. Ward, Peab. Acad.); *Japan* (Miers); *Mauritius* (A. M.-Edw.).

Genus **UTICA** White, 1847.

Carapax depressed, sides more or less arcuate, two-toothed. Antennulæ oblique. Antennæ entering the orbit. Meros of external shorter than the ischium, its external angle not expanded. Posterior feet compressed.

Synopsis of Species.

Inner margins of fingers strongly haired.

barbimanus.

Hands naked.

Angles of front acute.

gracilipes.

Angles of front rounded.

glabra.

U. gracilipes White.

Utica gracilipes White, Proc. Zool. Soc., 1847, p. 86. Adams and White, Voyage Samarang, Crust., p. 53, Pl. XIII, f. 6 (1850).

Philippines (White.)

U. glabra A. Milne-Edwards.

Utica glabra A. M.-Edw., Nouv. Arch. du Mus., ix, p. 296, Pl. XIV, f. 3 (1878).

New Caledonia (A. M.-Edw.).

U. barbimanus A. Milne-Edwards.

Utica barbimanus A. M.-Edw., l. c., p. 297, Pl. XIV, f. 4 (1873).

New Caledonia (A. M.-Edw.)

Genus **GLYPTOGRAPSUS** Smith, 1870.

Carapax transverse, distinctly areolate, sides arcuate, three-toothed. Antennæ entering the orbit. External maxillipeds nearly meeting. Ischium and meros nearly equal in length, very broad, the meros being broader than long, its external distal angle not expanded. Ambulatory feet elongate, the dactyli quadrangular and spinose.

G. impressus Smith.

Glyptograpsus impressus Smith, Trans. Conn. Acad., ii, p. 154 (1870).

Acajutla, West Coast of Central America (Smith).

Genus **HETEROGRAPSUS** Lucas, 1849.

(*Pseudograpsus*, pars, Edw., Dana; *Hemigrapsus* Dana.

Carapax arcuate, front inclined, antero-lateral margins dentate. External maxillipeds nearly closing. The meros as long or longer than broad, and bearing the palpus on the middle of its anterior border, the exognath narrow.

As the distinctions between the species are mainly comparative and the descriptions of authors are very brief, no synopsis can be given. The species may however be divided into two sections, according to the number of teeth on the antero-lateral margin.

A. *Antero-lateral margin with two teeth behind the orbital angle.*

H. lucasii Edwards.

Heterograpsus sexdentatus Lucas, Exploration Algiers, i, p. 19, Pl. II, f. 4 (1849), (nec Edwards¹).

Heterograpsus lucasii Edwards, Ann. Sci. Nat., III, xx, p. 192 (1853).

Carapax regularly arcuate, epigastric lobes but slightly indented. Front four-lobed. Antero-lateral margin with two prominent, narrow, acute teeth. Chelipeds without spines or tubercles, the hands of the male are smooth and rounded, in the female they have a double crest above and two elevated lines on the outer surface.¹ Ambulatory feet slender, naked; dactyli long and slender.

Algiers! (Dr. T. B. Wilson); *Candia* (Edwards).

H. sexdentatus Edwards.

Cyclograpsus sexdentatus Edwards, Hist. Nat. Crust., ii, p. 79 (1837).

Hemigrapsus sexdentatus Dana, U. S. Expl. Exped., Crustacea, p. 348, Pl. XXII, f. 2 (1850).

Heterograpsus sexdentatus Edwards, Ann. Sci. Nat., III, xx, p. 192, Pl. vii, f. 7 (1853).

Carapax arcuate, surface uneven, laterally granulate. Epigastric lobes prominent. Front straight. Antero-lateral margin with two teeth behind the orbital angle, the teeth broad, the emarginations narrow. Chelipeds without spines or tubercles. Hands small, fingers excavate. Ambulatory feet moderate, naked; dactyli short and stout.

Australia! (E. Wilson); *New Zealand!* (Dr. T. B. Wilson); *Bay of Islands* (Dana).

¹ Milne-Edwards (l. c., p. 192,) divides this section of the genus into two groups, one with the hands rounded and without longitudinal crests, the other with crests a division which evidently cannot be maintained.

H. sanguineus Edwards ex De Haan.

Grapsus sanguineus De Haan, Fauna Japonica, Crustacea, p. 58, Pl. XVI, f. 3 (1835).

Grapsus marmoratus White, Cat. Brit. Museum, Crust., p. 41, 1847 (*sine descr.*).

Pseudograpsus nudus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249. Expl. Exped., Crust., p. 335, Pl. XX, f. 7 (1852).

Heterograpsus sanguineus, marmoratus et maculatus Edw., Ann. Sci. Nat., III, xx, p. 193 (1853).

Heterograpsus nudus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 104.

Carapax posteriorly nearly flat, in front arcuate, with scattered punctæ and a curved line of larger depressions running inward from the last tooth of the lateral margin. Front obsoletely two-lobed; antero-lateral margin with two teeth closely similar to those of *H. sexdentatus*. Chelipeds smooth, with small red spots, which persist in alcoholic or dried specimens. Hands with an external crest, becoming obsolescent with age; fingers excavate. Ambulatory feet short, stout, naked, punctate; the dactyli very stout.

California! (many localities and collectors); *Vancouver Is.!* (Dr. A. S. Packard, Jr., in Peabody Acad. Science); *San Lorenzo, Gulf of California!* (Wilkes' Expedition); *Australia!* (E. Wilson); *Japan* (De Haan); *Punipet and Auckland* (Heller); *Hong Kong* (Stimpson); *Sitka* (White); *Polynesia* (Edwards).

H. crassimanus Kingsley ex Dana.

Hemigrapsus crassimanus Dana, Proc. Phila. Acad., 1851, p. 250.

U. S. Ex. Exped., Crust., p. 349, Pl. XXII, f. 4 (1852).

Hawaiian Is. (Dana).

H. crenulatus Edwards ex Guérin.

Grapsus crenulatus Guérin, Voy. Coquille, ii, pt. i, p. 15 (1838).¹

Cyclograpsus crenulatus Edw., Hist. Nat. Crust., ii, p. 80 (1837).

Hemigrapsus crenulatus Dana, U. S. Ex. Ex., Crust., p. 349, Pl. XXII, f. 3 (1852).

Heterograpsus crenulatus Edwards, Ann. Sci. Nat. III, xx, p. 193 (1853).

Heterograpsus barbigerus Heller, Verh. Z. B. Gesellschaft Wien, 1862, p. 522.

Heterograpsus barbimanus Heller, Novara Crustacea, p. 53, Pl. IV, f. 5 (1867).

Australia (Guérin); *New Zealand* (Edwards); *Bay of Islands* (Dana); *Punipet and Auckland* (Heller).

¹ The title bears the date 1830, the introduction to the Crustacea and Arachnida, "15 Novembre 1838," and the plates 1826. Guérin in his description, refers to Milne-Edwards' classic work as then in manuscript.

H. elongatus A. M.-Edw.

Heterograpsus elongatus Alph. Milne-Edwards, Nouv. Arch. du Museum, ix, p. 317, Pl. XVII, f. 5 (1873).

New Caledonia (A. M.-Edw.).

H. oregonensis Stimpson ex Dana.

Pseudograpsus oregonensis Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 248. Expl. Exped. Crust., p. 334, Pl. XX, f. 6 (1852).

Heterograpsus oregonensis Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Carapax depressed, anteriorly irregularly roughened; proto-gastric lobes defined. Front four-lobed, the inner lobes the more prominent. Antero-lateral margin with two prominent teeth. Chelipeds without spines or tubercles. Hands with an elevated line on the lower outer surface, the inner surface of the hand of the male with a pilose spot. Ambulatory feet moderate, ciliate.

Pacific Coast of North America from Puget Sound! (Geo. Davidson); to Santa Cruz! (Miss Hecox).

There are two specimens belonging to this species in the Museum of the Academy, bearing the label "New Providence, W. I., Dr. H. C. Wood, Jr."

H. penicillatus Stimpson ex De Haan.

Eriocheir penicillatus De Haan, op. cit., p. 60, Pl. XI, f. 6 (1835).

Heterograpsus penicillatus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Japan (De Haan).

H. erythræus Kingsley ex Kossmann.

Pseudograpsus erythræus Kossmann, Reise in den Küstengebiete des rothen Meeres, p. 61, Pl. 1, f. 5 (1877).

Red Sea (Kossmann).

H. pallipes Milne-Edwards.

Pseudograpsus pallipes Edw., Hist. Crust., ii, p. 82 (1837).

Heterograpsus pallipes Edw., Ann. Sci. Nat., III, xx, p. 194 (1858)..

Australia (Edw.).

B. Antero-lateral margin with three teeth behind the orbital angle.**H. octodentatus** Edwards.

Cyclograpsus octodentatus Edwards, Hist. Nat. Crust., ii, p. 80 (1837).

Heterograpsus octodentatus Edwards, Ann. Sci. Nat., III, xx, p. 194 (1853).

Locality unknown.

H. affinis Kingsley ex Dana.

Hemigrapsus affinis Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 250. U. S. Exp. Exped., Crustacea, p. 350, Pl. XXII, f. 5 (1852).

Patagonia (Dana).

H. spinosus Edw.

Heterograpsus spinosus Edw., Ann. Sci. Nat., III, xx. p. 194 (1853).
Vanikoro (Edw.); *Australia* (A. M.-Edw.).

Genus **ERIOCHEIR** De Haan (1835).

Carapax quadrate, antero-lateral margin two-toothed. Front much less than half the width of the carapax. Antennulæ oblique. Antennæ not excluded from the orbit. External maxillipeds nearly closing. Meros as long as broad, the external distal angle not expanded and the carpus articulating with the middle of its anterior border.

Synopsis of Species.

Sides convex.

Mesial frontal lobes rounded.

japonicus.

Frontal lobes acute.

sinensis.

Sides straight.

rectus.

E. japonicus De Haan.

Eriocheir japonicus De Haan, op. cit., p. 59, Pl. XVII (1835).

Carapax nearly flat, surface uneven. Front four-lobed, mesial lobes rounded, outer lobes acute; protogastric lobes prominent, granulate. Antero-lateral border two-toothed, with indications of a third. Meros of chelipeds with the margins granulate, the posterior terminating in an acute tooth. Carpus with a prominent internal spine; distal margin of the carpus and external surface of the hand with thickly set long hair; the inner surface of the palm with a short horizontal line of granules. Fingers sub-excavate. Ambulatory feet hairy above.

Japan! (no donor's name).

E. sinensis.

Eriocheir[us] sinensis Edw., Ann. Sci. Nat., III, xx, p. 177 (1853).
 Arch. du Mus., vii, p. 146, Pl. IX, f. 1 (1854).

China (Edw.).

E. rectus.

Eriocheir rectus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858 p. 103.

Macao (Stimpson).

Genus **PERIGRAPUS** Heller, 1862.

Carapax convex, sides arcuate, with one tooth behind the angle of the orbit. Front narrower than half the width of the carapax. Meros of the external maxilliped a little longer than broad and bearing the palpus on the external angle. Dactyli of ambulatory feet spined.

P. excelsus Heller.

Perigrapsus excelsus Heller, Verh. Zool. Bot. Ges. Wien, 1862, p. 522.
 Novara Crust., p. 50, Pl. V, f. 1 (1865).

Tahiti (Heller).

Genus **PLATYGRAPSUS** Stimpson, 1858 (*Platynotus* De Haan, 1835, preocc.).

Carapax flat. Front horizontal. Sides nearly straight, with two teeth behind the angle of the orbit. Meros of the external maxilliped longer than the ischium and bearing the palpus on the external angle.

P. depressus Stimpson ex De Haan.

Platynotus depressus De Haan, Fauna Japonica, Crust., p. 63, Pl. VIII, f. 2 (1835).

Platygrapsus depressus et convexiusculus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 104.

Carapax depressed, smooth; front horizontal, four-lobed, mesial lobes the larger; sides with two teeth behind the angle of the orbit, the posterior tooth indistinct. Chelipeds smooth and unarmed; meros with the anterior margin acute; carpus without spines or tubercles; hand with an elevated line on the lower outer surface; fingers slender, gaping. Ambulatory feet elongate.

Japan! (no donor's name); *Hong Kong* (Heller); *Loo Choo* (Stimpson).

Tribe **SESARMINI** (Sub-family *Sesarminæ* Dana).

Meros and ischium of the external maxillipeds crossed obliquely by a piliferous ridge.

Genus **METASESARMA** Edw (1853).

Carapax quadrate, sides but slightly arcuate, entire; front broad, deflexed. Sub-orbital lobe large, meeting the front and excluding the antennæ from the orbit. Meros of external maxilliped greatly elongate, its apex rounded.

Synopsis of Species.

Hands smooth, externally and above.

rousseauxi.

Hand roughened above.

granularis.

Hand roughened above and externally.

trapezium.

M. rousseauxi Edw.

Metasesarma rousseauxi Edw., Ann. Sci. Nat., III, xx, p. 88 (1853).
 Arch. du Mus., vii, p. 158, Pl. X, f. 1 (1854).

Zanzibar (Edw.).

M. granularis¹ Heller.*Metasesarma granularis* Heller, Verh. Z. B. Ges. Wien, 1862, p. 522.*Metasesarma rugulosa* Heller, Novara Crust., p. 65 (1865).

Tahiti (Heller).

M. trapezium Stimpson ex Dana.*Sesarma trapezium* Dana, U. S. Expl. Exped. p. 354, Pl. XXII, f. 8 (1852).*Metasesarma trapezium* Stimpson, Proc. Acad. Nat. Sci. Phila., 1861, p. 373.

Sandwich Is. (Dana).

Genus **SARMATIUM** Dana, 1851 (*Metagrapsus* Edw., 1853).

Carapax convex, sides arcuate, entire or toothed. Front inclined, less than half the width of the carapax. External maxillipeds nearly as in *Sesarma*. Ambulatory feet with the margins entire.

Synopsis of Species.

Sides of carapax with two teeth behind the orbital angle.

Hands externally smooth and rounded.

Carapax smooth, hand transversely plicate above.

crassum.

Carapax areolate, hand smooth above.

curvatum.

Hands externally roughened.

Hands externally bearing a pectinate crest.

pectinatum.

Hands without a prominent external crest.

Hands with an internal granulate ridge.

punctatum.

Hands entire within.

indicum.

Sides of carapax entire.

*integrum.***S. crassum** Dana.*Sarmatium crassum* Dana, Proc. Acad. Nat. Sci. Phila., 1851, p.

U. S. Expl. Exped., Crust., p. 358, Pl. XXIII, f. 1 (1852).

Samoan Is. (Dana).

S. curvatum Kingsley ex Milne-Edwards.*Sesarma curvata* Edw., Hist. Crust., ii, p. 75 (1837).*Metagrapsus curvatus* M.-Edw., Ann. Sci. Nat. III, xx, p. 189 (1853).

Arch. du Mus., vii, p. 160, Pl. X, f. 3, 1854.

Senegal (Edw.).

S. pectinatum Kingsley ex Milne-Edwards.*Metagrapsus pectinatus* Edw., Ann. Sci. Nat. III, xx, p. 189 (1853).

Martinique (Edw.).

S. punctatum Kingsley ex A. Milne-Edwards.*Metagrapsus punctatus* A. M.-Edw., Nouv. Arch. du Mus., ix, p. 308, Pl. XVII, f. 2 (1873).

New Caledonia (A. M.-Edw.).

¹ I have here as in other places employed the earlier name; what reason Dr. Heller had for the change I cannot imagine.

S. indicum Kingsley ex A. Milne-Edwards.

Metagrapsus indicus A. M.-Edw., Nouv. Arch. du Mus., iv, p. 174, XXVI, f. 1-5 (1868).

Celebes (A. M.-Edw.).

S. integrum Kingsley ex A. Milne-Edwards.

Metagrapsus integer A. M.-Edw., Nouv. Arch. du Mus., ix, p. 309, Pl. XVII, f. 3 (1873).

New Caledonia (A. M.-Edw.).

Genus **RHACONOTUS** Gerstæcker, 1856.

Carapax sub-quadrate, sides arcuate, toothed. Front narrow, about one-third the width of the carapax. Meros of external maxillipeds nearly as broad as long and about half the length of the ischium. Ambulatory feet compressed, the margins of the joints serrate.

R. crenulatus Gerstæcker.

Rhacnotus crenulatus Gerstæcker, Archiv für Naturgeschichte, xxi, p. 142 (1856).

Locality unknown.

Genus **SESARMA** Say, 1818. (*Pachysoma* De Haan, 1835. *Holometopus* Edw., 1853.)

Carapax thick, quadrate, lateral margins straight, entire or toothed. External maxillipeds with an oblique piliferous ridge crossing the ischium and meros; the meros elongate, its apex rounded. Antennæ entering the orbit.

I have not attempted to revise the species of this genus on account of a lack of sufficient material. I merely give a list of the described species, indicating in a few cases the synonymy, but leaving the task of comparing a large number of poor descriptions to some future carcinologist.

S. affinis Edw. (= ? *quadrata*).

Grapsus (*Pachysoma*) *affinis* De Haan, op. cit., p. 61, Pl. XVIII, f. 5 (1835).

Sesarma affinis Edwards, Ann. Sci. Nat., III, xx, p. 183 (1853).

Japan (De Haan); *China* (Edw.); *Natal* (Krauss).

S. africana Edwards.

Sesarma africana Edw., Hist. Nat. Crust., ii, p. 73 (1837).

Senegal (Edw.).

S. americana Saussure.

Sesarma americana Saussure, Mem. Soc. Phys. et Hist. Nat., xiv, p. 441 (1858).

St. Thomas, W. I. (Saussure).

S. angolensis Capello.

Sesarma angolensis Capello, Descr. tres sp. Nov. Crust. du Africa Occident, p. 4, f. 2 (1864).

Angola, West Africa (Capello).

S. angusta Smith.*Sesarma angusta* Smith, Trans. Conn. Acad., ii, p. 159 (1870).

Panama (Smith).

S. angustifrons A. Milne-Edwards.*Sesarma angustifrons* A. M.-Edw., Nouv. Arch. du Mus. Bulletin, v, p. 26 (1869).

Sandwich Is. (A. M.-Edw.).

S. angustipes Dana.*Sesarma angustipes* Dana, U. S. Expl. Exped., Crust., p. 853, Pl. XXII, f. 7 (1852).

Florida! West Indies! Brazil!

S. aspera Heller.*Sesarma aspera* Heller, Novara, Crust., p. 63, Pl. VI, f. 2 (1865).

Nicobars, Ceylon, Madras (Heller).

S. atrorubens Hess.*Sesarma atrorubens* Hess, Archiv für Naturgeschichte, xxxi, p. 149, Pl. VI, f. 12 (1865).

Sydney, Australia (Hess).

S. aubryi A. Milne-Edwards.*Sesarma aubryi* A. M.-Edw., Nouv. Arch., Bulletin, v, p. 25 (1869).
Nouv. Arch., ix, p. 307, Pl. XVI, f. 3 (1873).

New Caledonia (A. M.-Edw.).

S. bidens Milne-Edwards ex De Haan.*Grapsus (Pachysoma) bidens* De Haan, op. cit., p. 60, Pl. XVI, f. 4, Pl. XI, f. 4 (1835).*Sesarma bidens* Edw., Ann. Sci. Nat., III, xx, p. 185 (1853).

Japan (De Haan); Hong Kong, Nicobars (Heller); Friendly Is. (Dana); Ceylon, Zanzibar (Hilgendorf).

S. boucourti A. Milne-Edwards.*Sesarma boucourti* A. M.-Edw., Bulletin, l. c., p. 28 (1869).

Siam (A. M.-Edw.).

S. chirogona Tozzetti.*Sesarma chirogona* Targioni-Tozzetti, Zoologia del Viaggio della Magenta, p. 136, Pl. IX (1877).

Yokohama (Tozzetti).

S. cinereus Say ex Bosc.*Grapsus cinereus* Bosc., Hist. Nat. Crust., i, p. 204 Pl. V, f. 1, 1802-3 (teste Auct.).*Sesarma cinerea* Say, Jour. Acad. Nat. Sci., Phila., i, p. 442 (1818).
Virginia! to Florida! and the West Indies!**S. dentifrons** A. Milne-Edwards.*Sesarma dentifrons* A. M.-Edw., Bulletin, l. c., p. 31 (1869).

Samoan Is. (A. M.-Edw.).

S. dehaani Milne-Edwards.*Grapsus (Pachysoma) quadratus* De Haan, op. cit. p. 62, Pl. VIII, f. 3 (1835).*Sesarma dehaani* Edw., Ann. Sci. Nat., III, xx, p. 184 (1853).

Japan (De Haan).

S. dusumieri Milne-Edwards (= *S. bidens*).*Sesarma dusumieri* Edw., Ann. Sci. Nat., III, xx, p. 185 (1853).

Bombay (Edw.).

S. elegans Herklots.*Sesarma elegans* Herklots, Addit. ad Faunam Afric. Occident., p. 10, Pl. I, f. 10 (1851).

Boutry, West Africa (Herklots).

S. elongata A. Milne-Edwards.*Sesarma elongatum* A. M.-Edw., Bulletin, l. c., p. 30 (1869).

Madagascar (A. M.-Edw.).

S. erythrodictyla Hess.*Sesarma erythrodictyla* Hess, Arch. für Naturges., xxxi, p. 151, Pl. VI, f. 10 (1865).

Sydney, Australia (Hess).

S. eydouxi Milne-Edwards.*Sesarma eydouxi* Edw., Ann. Sci. Nat., III, xx, p. 184 (1853).

Cochin China (Edw.); Madras (Heller).

S. fascicularis Hilgendorf ex Herbst.*Cancer fascicularis* Herbst, Krabben und Krebse, Pl. XLVII, f. 5 (1795).*Sesarma mederi* Edw., Ann. Sci. Nat., III, xx, p. 185 (1853) teste Hilgendorf.

Batavia (Edw.).

S. frontale A. Milne-Edwards.*Sesarma frontale* A. M.-Edw., Bulletin, l. c., p. 27 (1869).

Madagascar (A. M.-Edw.).

S. germani A. Milne-Edwards.*Sesarma germani* A. M.-Edw., Bulletin, l. c., p. 28 (1869).

Poulo Condore.

S. gracilipes A. Milne-Edwards.*Sesarma impressa* jun. Homb. et Jacq., Voy. Ast. et Zelee, Crust., Pl. VI, f. 5.*Sesarma gracilipes* Edw., Ann. Sci. Nat., III, xx, p. 182 (1853).

Vaoa (Edw.); Nicobars (Heller).

S. guerini Milne-Edwards.*Sesarma guerini* Edw., Ann. Sci. Nat., III, xx, p. 183 (1853).

Locality unknown.

S. guttatum A. Milne-Edwards.*Sesarma guttatum* A. M.-Edw., Bulletin, l. c., p. 26 (1869).

Zanzibar (A. M.-Edw.).

S. hæmatocheir Kingsley ex De Haan.*Grapsus (Pachysoma) hæmatocheir* De Haan, op. cit. p. 67, Pl. VII, f. 4 (1837).*Holometopus hæmatocheir*¹ Edw., Ann. Sci. Nat., III, xx, p. 188 (1853).

Japan (De Haan).

¹ M. Milne-Edwards has elevated this species to distinct generic rank on what seem to me wholly inadequate characters. A similar proceeding with other *Sesarmæ* would result in the creation of nearly a dozen genera.

S. impressa Milne-Edwards.*Sesarma impressa* Edw., Hist. Nat. Crust., ii, p. 74 (1837).

Locality unknown.

S. indica Milne-Edwards.*Sesarma indica* Edw., Hist. Nat. Crust., i i, p. 74 (1837).

Indian Seas (Edw.); Ceylon and Nicobars (Heller).

S. intermedia Milne-Edwards ex De Haan.*Grapsus (Pachysoma) intermedia* De Haan, op. cit., p. 61, Pl. XVI, f. 5 (1835).*Sesarma intermedia* Edw., Ann. Sci. Nat., III, xx, p. 186 (1853).*Sesarma læve* A. M.-Edw., Bulletin, l. c., p. 27 (1869).Japan (De Haan); Shanghai, Hong Kong (Heller);
Arrow Is. (A. M.-Edw.).**S. lafondi** Jacquinot et Lucas.*Sesarma lafondi* Jacquinot et Lucas, Voyage Astrolabe et Zelee, Crust., p. 70, Pl. VI, f. 4 (1853).

Batavia (J. and L.).

S. leptosoma Hilgendorf.*Sesarma leptosoma* Hilgendorf, in Decken's Reise, p. 91, Pl. VI, f. 1 (1869).

Zanzibar (Hilgendorf).

S. lividum A. Milne-Edwards.*Sesarma lividum* A. M.-Edw., Bulletin, l. c., p. 25 (1869), N. Arch., ix, p. 303, Pl. XVI, f. 2 (1873).

New Caledonia (A. M.-Edw.).

S. longipes Krauss.*Sesarma longipes* Krauss, Süd Afric. Crust., p. 444, Pl. III, f. 2 (1843).
Umlass River, S. Africa (Krauss).**S. Müllerii** A. Milne-Edwards.*Sesarma mülleri* A. M.-Edw., Bulletin, l. c., p. 29 (1869).

Desterro, Brazil (A. M.-Edw.).

S. obesum Dana.*Sesarma obesum* Dana, Proc. Phila. Acad., 1851, p. 250; U. S. Expl. Exped., Crust., p. 353, Pl. XXII, f. 10.

Balabac Straits (Dana).

S. oblonga Martens.*Sesarma oblonga* Martens, Monatsber. Akad. Wiss. Berlin, 1868, p. 611.
Philippines (Martens).**S. obtusifrons** Dana.*Sesarma obtusifrons* Dana, Proc. Phila. Acad. 1851, p. 250; U. S. Expl. Exped., Crust., p. 355, Pl. XXII, f. 9 (1852).

Sandwich Is. (Dana).

S. occidentalis Smith.*Sesarma occidentalis* Smith, Trans. Conn. Acad., ii, p. 158 (1870).

West Coast of Central America (Smith).

S. pentagona Hutton (= ? *S. tetragona*).*Sesarma pentagona* Hutton, Trans. New Zealand Inst., 1875, p. 279.

New Zealand (Hutton).

S. quadrata Milne-Edwards ex Fabricius.

Cancer quadratus Fabr., Suppl. Ent. Syst., p. 341 (1798).

Ocypoda plicatu Bosc., op. cit., i, p. 198, 1802-3 (teste A. M.-Edw.).

Grapsus (Pachysoma) pictus et affinis De Haan, op. cit., pp. 61-66 (1835-37).

Sesarma quadrata Edw., Hist. Nat. Crust., ii, p. 75 (1837).

Sesarma picta Krauss, op. cit., p. 45 (1843).

Japan (De Haan); *New Caledonia* (A. M.-Edw.); *Zanzibar* (Hilgendorf).

S. recta Randall.

Sesarma recta Randall, Jour. Acad. Nat. Sci., Phila., viii, p. 123 (1839).

Surinam! (Randall).

S. reticulata, Say.

Sesarma reticulata Say, Jour. Acad. Nat. Sci., Phila., i, pp. 73, 76 et 442, Pl. IV, f. 6 (1818).

Sesarma cinerea De Kay, N. Y. Fauna, Crust., p. 15 (1842).

Virginia! to Florida!

S. ricordi Milne-Edwards.

Sesarma ricordi Edw., Ann. Sci. Nat., III, xx, p. 183 (1853).

Hayti (Edw.).

S. roberti Milne-Edwards.

Sesarma reticulata McLeay in Smith Zool. S. Africa, p. 65 (18), viz Say.

Sesarma roberti Edw., Ann. Sci. Nat., III, xx, p. 182 (1853).

Gori! (Dr. Wilson); So. Africa (McLeay).

S. rotundata Hess.

Sesarma rotundata Hess, l. c., p. 149, Pl. VI, f. 9 (1865).

Sydney (Hess).

S. rotundifrons A. Milne-Edwards.

Sesarma rotundifrons A. M.-Ed., Bulletin, l. c. p. 30 (1869).

Samoan Is. (A. M.-Edw.).

S. rupicola Stimpson.

Sesarma rupicola Stimpson, Proc. Phila. Acad., 1858, p. 106.

Japan (Stimpson).

S. schüttei Hess.

Sesarma schüttei Hess, l. c., p. 150, Pl. VI, f. 11 (1865).

Sydney, Australia (Hess).

S. similis Hess (= *S. atrorubens*).

Sesarma similis Hess, l. c., p. 150 (1865).

Sydney (Australia).

S. sinensis Milne-Edwards.

Sesarma sinensis Edw., Ann. Sci. Nat., III, xx, p. 186 (1853).

China (Edw.).

S. smithii Milne-Edwards.

Sesarma smithii Edw., Ann. Sci. Nat., III, xx, p. 187 (1853); Arch. du Mus., vii, p. 149, Pl. IX, f. 2 (1854).

Natal (Edw.); *New Caledonia* (A. M.-Edw.).

S. sulcata Smith.*Sesarma sulcata* Smith, Trans. Conn. Acad., ii, p. 156 (1870).*Corinto, Nicaragua!* (J. A. McNeil, Peab. Acad.)**S. tæniolata** Miers *ex* White MS.*Sesarma tæniolata* White MS., Miers, Proc. Zool. Soc., London (1877), p. 137.*Philippines!* (Dr. Wilson, with White's label).**S. tetragona** Milne-Edwards *ex* Fabricius.*Cancer tetragonon* Fabricius, Suppl. Ent. Syst., p. 341 (1798).*Grapsus tetragonon* Latr., Hist. Crust. et Ins., vi, p. 71 (1803-4).*Sesarma tetragona* Edw., Hist. Nat. Crust., ii, p. 73 (1837).*Zanzibar* (Hilgendorf) to *New Caledonia* (A. M.-Edw.).**S. trapezoida** Milne-Edwards.*Sesarma trapezoida* Edw., Hist. Nat. Crust., ii, p. 74 (1837).*Locality unknown.***S. unguolata** Milne-Edwards.¹*Sesarma unguolata* Edw., Ann. Sci. Nat. III, xx, p. 184 (1853).*Celebes* (Edw.).**S. vestita** Stimpson.*Sesarma vestita* Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 106.*Japan* (Stimpson).**S. villosum** A. Milne-Edwards.*Sesarma villosum* A. M.-Edw., Bulletin, l. c., p. 31 (1869).*Samoa Is.* (A. M.-Edw.).**S. violacea** Herklots.*Sesarma violacea* Herklots, op. cit., p. 10, Pl. I, f. 9 (1851).*West Africa!* (Du Chaillu).Genus **ARATUS** M.-Edw., 1853.

Carapax trapezoidal, elongate, narrow behind, sides straight, entire; front deflexed, very broad. External maxillipeds as in *Sesarma*. Ambulatory feet compressed, the dactyli very short.

A. pisoni Milne-Edwards.*Sesarma pisoni* Edw., Hist. Crust., ii, p. 76, Pl. XVI, f. 4-5 (1837).*Aratus pisoni* Edw., Ann. Sci. Nat., III, xx, p. 187, 1853.

Carapax transversely arcuate, the branchial regions obliquely plicate. Front vertical, its margin two-lobed. Meros of chelipeds triquetral, the margins denticulate, the anterior one slightly expanded distally. Carpus externally granulate. Hands everywhere granulate, the fingers ornamented with pencils of stiff black hairs.

Florida! (H. E. Webster, Union College); *West Indies!* (many collectors and localities); *West Coast of Nicaragua!* (J. A. McNeil, Peab. Acad.); *Rio Janeiro* (Heller); *Praya, Brazil* (Martens).

Genus **CLISTOCCELOMA** A. M.-Edwards, 1873.

Carapax sub-quadrate, sides dentate. Sub-ocular lobe large, united to the front and excluding the antennæ from the orbit. Meros of external maxillipeds short and rounded.

C. balansæ A. Milne-Edwards.

Clistoceloma balansæ A. M.-Edw., Nouv. Arch. du Mus., ix, p. 311, Pl. XVII, f. 1 (1873).

New Caledonia (A. M.-Edw.).

Genus **HELICE** De Haan (1835).

Carapax quadrate, front deflexed, sides straight, with one, two or three teeth behind the orbital angle. Antennæ entering the orbit. Meros of external maxillipeds as long as or longer than the ischium, its external distal angle prominent, its distal border truncate.

Synopsis of Species.

Lateral margin with three teeth behind the angle of the orbit.

Ambulatory feet with a single distal spine on the meros.

A transverse ridge on the branchial regions.

tridens.

No transverse crest on the branchial regions.

Hands smooth.

spinicarpa.

Hands roughened.

latreillei.

Meral joints of ambulatory feet with several spines.

dentipes:

Lateral margin two-toothed.

Hand strongly granulate.

gaudichaudi.

Hand nearly smooth.

Meral joints of ambulatory feet with a spine on the upper distal margin, the hands of the male with a pilose spot at the base of the fingers.

pilimana.

Meral joints without spines, hands of male without pilose spots.

crassa.

Lateral margin one-toothed.

gibba.

Imperfectly characterized.

leachii.

H. tridens De Haan.

Helice tridens De Haan, op. cit., p. 57, Pl. XI, f. 2, Pl. XVI, f. 6 (1835).

Carapax longitudinally strongly convex, punctate, front curved downward, its anterior border sinuate when viewed from above. Superior margin of the orbit sinuate, oblique; lateral margin with three teeth behind the orbital angle, the posterior tooth rudimentary. Branchial regions with an oblique ridge running inward from this tooth. Orbits coarsely crenulate below. Inferior borders of the meral joints of the chelipeds with small tubercles. Carpus spined on the inside. Hands externally

smooth, sub-cristate and granulate above, internally granulate; fingers excavate. Carpal and propodal joints of the first two pairs of ambulatory feet pilose in front.

Japan!

H. spinicarpa Edwards.

H. spinicarpa Edwards, Ann. Sci. Nat. III, xx, p. 190 (1853).

Locality unknown.

H. dentipes Heller.

Helice dentipes Heller, Novara Crust., p. 62, Pl. V, f. 5.

Ceylon (Heller).

H. latreillei Edwards.

Cyclograpsus latreillei Edwards, Hist. Nat. Crust., ii, p. 80 (1837).

Helice latreillei Edwards, Ann. Sci. Nat. III, xx, p. 190 (1853).

Mauritius (Edwards).

H. gaudichaudi Edwards.

Helice gaudichaudi Edwards, Ann. Sci. Nat. III, xx, p. 190, Pl. VII, f. 6 (1853).

Sumatra (Edwards).

H. pilimana A. Milne-Edwards.

Helice pilimana Alph. Milne-Edwards, Nouv. Arch. du Mus., ix p. 313, Pl. XVIII, f. 1 (1872).

New Caledonia (A. M.-Edw.).

H. crassa Dana.

Helice crassa Dana, Proc. Phila. Acad. (1851), p. 252—U.S. Ex. Exp., Crust., p. 367, Pl. XXIII, f. 8 (1853).

H. lucasii Edw., Ann. Sci. Nat. III, xx, p. 190 (1853).

Carapax closely resembling that of *H. tridens*, but with but two teeth behind the orbital angle. Carpus of cheliped without an internal spine, hands externally microscopically granulate, more coarsely so internally, the upper margin acute. Carpal and propodal joints of the first two pairs of ambulatory feet, pilose.

This is probably but a variety of *H. tridens*. Small females show the elevated line on the hand characterizing *H. lucasii*.

New Zealand! (Dr. Wilson); Auckland (Heller); Australia (Dana).

H. leachii Hess.

Helice leachii Hess, Archiv für Naturgeschichte, xxxi, p. 153 (1865).

Sydney, Australia (Hess).

Genus **CYCLOGRAPSPUS** Edw. (1837)(restrict). (*Gnathochasmus* McLeay.)

Carapax depressed, sides arcuate, entire front about half the width of the carapax. Antenna not excluded from the orbit. Meros of the external maxillipeds short, about as long as the ischium; its external angle well marked, the palpus articulating with the anterior margin.

C. punctatus Milne-Edwards.

Cyclograpsus punctatus Edw., Hist. Nat. Crust., ii, p. 78 (1837).

Gnathochasmus barbatus McLeay, in Smith, Zool. S. Africa, p. 65 (1838).

Sesarma barbata Krauss, Sud Af. Crust., p. 45, Pl. III, f. 3 (1843).

Cyclograpsus audouinii, lacauxii, whitei, granulatus et reynaudi Edw., Ann. Sci. Nat. III, xx, p. 197 (1853).

Cyclograpsus laevis Hess, Archiv für Naturgeschichte, xxxi, p. 152 (1865).

Carapax smooth or slightly granulate; sides arcuate in front, straight behind. Front broad, nearly straight. Orbits externally broadly emarginate, the emargination continuing backward as a groove for some distance. Hands externally smooth, internally with a prominent longitudinal ridge. Male abdomen triangular, regularly tapering from the third to the sixth joints, the seventh much narrower than the sixth.

New Zealand! (Guerin); *Australia!* (E. Wilson and Wilkes' Expedition); *Cape of Good Hope, Madras, Java* (Heller); *New Guinea* (Edw.).

C. granulatus Dana.

Cyclograpsus granulatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 251; U. S. Ex. Exp. Crust., p. 361, Pl. XXIII, f. 4 (1852).

Sandwich Is. (Dana).

C. cinereus Dana.

Cyclograpsus cinereus Dana, Proc. Acad. (1851), p. 251; U. S. Ex. Exp. Crust., p. 360, Pl. XXIII, f. 3 (1852).

Cyclograpsus eydouxii Edw., Ann. Sci. Nat., III, xx, p. 198 (1853).

Valparaiso and Sandwich Is. (Dana).

C. longipes Stimpson.

Cyclograpsus longipes Stimpson, Proc. Acad. Nat. Sci. Phila. (1858), p. 105.

Bonin Is. (Stimpson).

C. integer Milne-Edwards.

Cyclograpsus integer Edw., Hist. Nat. Crust., ii, p. 79 (1837).

Florida! (A. S. Packard, Jr., Peab. Acad.); *Brazil* (Edw.).

Genus **CHASMAGNATHUS** DeHaan, 1835. (*Paragrapsus* Edw.).

Carapax convex, sides arcuate, dentate, front curved downward. Antenna not excluded from the orbit. Meros of external maxillipeds longer than broad, widest distally, its anterior border slightly excavate, the palpus medially articulated.

Synopsis of Species.

Lateral margin with three teeth behind the orbital angle, the posterior tooth inconspicuous.	<i>convexus.</i>
Lateral margin with two teeth.	
Front rounded.	<i>urvillei.</i>
Front nearly straight.	<i>gaimardi.</i>
Front excavate.	
Carapax and chelipeds granulate.	<i>granulatus.</i>
Carapax and chelipeds smooth.	
Epigastric lobes prominent.	<i>lævis.</i>
Epigastric lobes inconspicuous.	<i>subquadratus.</i>
Lateral margin with one post orbital tooth.	<i>quadridentatus.</i>

C. convexus DeHaan.

Chasmagnathus convexus DeHaan, Fauna Japonica, p. 56, Pl. VII, f. 5 (1835).

Japan (DeHaan); *Eastern Seas* (Adams and White).

C. subquadratus Dana.

Chasmagnathus subquadratus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 251; U. S. Ex. Exp., Crust., p. 363, Pl. XXIII, f. 5 (1852).

New Zealand? *Australia?* (Dana).

C. lævis Dana (= ? *C. subquadratus*.)

Chasmagnathus lævis Dana, Proc. Acad., p. 252; Ex. Exp., p. 365, Pl. XXIII, f. 7 (1852).

Paragrapsus verreauxi Edw., Ann. Sci. Nat., III xx, p. 195 (1853).

Paragrapsus lævis Heller, Novara Crust., p. 55 (1865).

Carapax slightly convex, punctate; regions not defined. Epigastric lobes prominent. Front deeply excavate in the middle, when viewed from above. Antero-lateral teeth separated by narrow fissures. Chelipeds everywhere smooth. Anterior surface of carpus and propodus of first pair of ambulatory feet tomentose.

Australia? (Guerin; *New Zealand* (Miers).

C. urvillei Kingsley ex Milne-Edwards.

Paragrapsus urvillei Edw., Ann. Sci. Nat., III, xx, p. 196 (1853).

Vanikoro I. (Edw.).

C. granulatus Dana.

Chasmagnathus granulatus Dana, Proc. Acad., 1851, p. 251; U. S. Ex. Exp., Crust., p. 364, Pl. XXIII, f. 6 (1852).

Helice granulata Heller, Novara Crust., p. 61 (1865).

Carapax convex, distinctly areolate, granulate; the granules on the branchial regions being larger; epigastric lobes obsolete. Front curved downward and, viewed from above, deeply excavate.

Sides of carapax acute, the fissures between the teeth being very slight; all of the border of the carapax finely crenulate. Chelipeds externally granulate. Carpus produced internally; the inner surface of the hand with a patch of granules on the inner surface. Carpal joints of the ambulatory feet longitudinally sulcate.

Rio Janeiro! (Wilkes' Expedition); *Rio Grande, Brazil!* (Capt. Harrington Peabody Academy).

C. gaimardi Milne Edwards.

Cyclograpsus gaimardi Edw., Hist. Nat. Crust., ii, p. 79 (1837).

Paragrapsus gaimardi Edw., Ann. Sci. Nat. III, xx, p. 196 (1853).

Australia (Edwards).

C. quadridentatus Kingsley ex Milne-Edwards.

Paragrapsus quadridentatus Edw., Ann. Sci. Nat., III, xx, p. 195 (1853).

Australia (Edw.).

Sub family **Plagusinæ** Dana.¹

Carapax flattened, antennulæ longitudinally plicate, lodged in sinuses of the front, and visible from above.

Genus **PLAGUSIA** Latr., 1806 (restrict).

Meros of external maxilliped well developed, as broad as the ischium.

P. speciosa Dana.

Carapax arcuate, covered everywhere with squamiform tubercles, the inter spaces being clothed with a short pubescence, these tubercles being similar in their arrangement to those of *P. depressa* Say, but much more depressed than in that species. The margins of the inter-antennular portion of the front is simple. Inferior margin of the orbit acute, minutely denticulate. Sides of carapax with two equal acute spiniform teeth behind the angle of the orbit. Feet closely resembling those of *P. depressa*, the ornamentation being similar, but not so prominent. The hands, however, are externally marked by six longitudinal impressed lines, the lowest of them being on the inferior margin. The fingers are widely gaping, the extremities deeply excavate. The dentiform process

¹ This sub family having recently been revised by Mr. Miers (Annals and Magazine of Natural History, V, ix, pp. 147-154, February, 1878), and as I agree with his determinations and ideas of specific limits, I omit the synopsis of species from this paper, merely giving a few notes on the more uncommon forms.

on the coxa of the third pair of ambulatory feet is minutely denticulate. The only additional character in the female is that the squamæ of the carapax are more depressed.

Mr. Miers (l. c., p. 151) remarks: "Only a carapax of this species is known." The carapax referred to, Dana's type, was destroyed in the Chicago fire. The Academy possesses two specimens, male and female, sent by Mr. Andrew Garrett, from Tahiti.

Genus **LEILOPHUS** ¹ Miers, 1876. (*Acanthopus* DeHaan.)

Meros of external maxillipeds very small, and much narrower than the ischium.

L. pilimanus Miers *ex* A. M.-Edw.

Specimens of this rare species are in the museum of the Academy, from the Sandwich Is. (J. K. Townsend) and Tahiti (A. Garrett). So far as I am aware, the only other specimen, in any collection, is the type in Jardin des Plantes at Paris. The British Museum has no specimens.

I am unable, either from the poorness of the descriptions, or possible inaccuracy of the figures, to assign the following species to their proper generic positions.

Cyclograpsus ? *tasmanicus* Jacquinot et Lucas, Voyage Astrolabe et Zélee, Crustaces, p. 76, Pl. VI, f. 6 (1842-53).

Tasmania (J. et L.).

Cyclograpsus minutus J. et L., l. c., p. 75, Pl. VI, f. 8 (1842-53).

Chili (J. et L.).

Grapsus inornatus Hess, Archiv für Naturgeschichte, xxxi, p. 148, Pl. VI, f. 11 (1865).

Sydney, Australia (Hess).

Grapsus huzardi Desmarest, Consid. sur les Crust., p. 131 (1825).

Senegal (Desmarest).

Cancer tridens Fabricius, Suppl. Ent. Syst., p. 340 (1798).

E. Indies (Fabricius).

Cancer hispanus Herbst, Pl. XXXVII, f. 1 (1796).

Goniograpsus pulcher Lockington, Proc. Cal. Acad., vii, p. 152 (1876).

Lower California (Lockington).

M. Henri Milne-Edwards (Archives du Museum, vii, p. 158, 1854) mentions a genus *Holograpsus*, possibly intending *Holomeopus*.

¹ In the dismemberment of the genus *Plagusia* of Latreille, the name *Plagusia* should have been retained for this section.

ther investigation, but thought it quite likely, in spite of the hypogynous flower, *Phytolacca* would be found more nearly related to *Solanaceæ* than to *Chenopodiaceæ*, near which it was now placed.

He then exhibited some shoots of Grape Vine, and said that Dr. Engelman had pointed out, when at the Academy last year, that there was some numerical order in the tendrils of grape vines. In the specimen he exhibited every third node had no tendril; but he had seen some grape vines in which as many as eight nodes with tendrils had followed one another. In the mature wood, however, those without tendrils perfected the strongest buds. But he had found in the allied genus *Ampelopsis* a nearly regular system of buds and tendrils. In *A. hederacea*, the common Virginia or five fingered creeper, the strong shoots running up a wall or tree had at every third node a strong axillary bud, *without any tendril*; while the two intervening nodes had tendrils *without axillary buds*. Occasionally, but very rarely, two successive nodes would have axillary buds, in which case the lower one would be smaller, and have also a small tendril on the opposite side. *Ampelopsis Vietchii* had the same character. He had attempted to propagate this by using nodes from which the tendrils pushed, as single bud cuttings, but failed to get any development from the axils. He believed they had not a trace of a bud in even the most rudimentary state. It had been said in Darwin's paper on motion in tendrils that the gland on the end of the tendril did not develop itself until it approached the object it was to cling to. In *Ampelopsis Vietchii*, they developed before this, in the shape of small globes, looking like rudiments of the same flower which ultimately appeared. In fact tendrils here were incipient flower branches, as any one could see by tracing the common *Ampelopsis hederacea* up to its final flowering condition, when, the axial growth ending in a terminal bud, instead of the usual lateral tendril, it seemed to erect itself and bear flowers. It would seem as if it was only by the elongation of the axis, demanding and drawing to itself nutriment which would otherwise go into the tendril, which made it a tendril, and not a flower shoot.

He did not, however, intend at this time to attempt any explanation of these series of observations. He thought there was nothing in any known law of *Phyllotaxis* which would explain them; and that by following them up matters of much interest to botany might be evolved. But, as he might have more to say about it some day, and winter was approaching, he thought to call the attention of the Academy to the facts, so that those interested might examine them for themselves before the frost destroyed the specimens.

The death of Mr. Wm. P. Wilstach was announced.

Sept. 27th.

The President, DR. RUSCHENBERGER, in the Chair.

Twenty-one members present.

The report of a Committee appointed to draft resolutions regarding the death of the late Wm. P. Wilstach was received, and the following Resolutions adopted:

The death of WILLIAM P. WILSTACH, at Saratoga, Sept. 17, 1870, has been announced to the Academy of Natural Sciences of Philadelphia.

Mr. WILSTACH during his connection of ten years with this institution has been distinguished among its members by his liberal, intelligent and prompt encouragement of every enterprise calculated to increase and diffuse knowledge of the Natural Sciences. Besides many donations at different times, he gave a thousand dollars towards the publication of the last volume of the Academy's Journal; a thousand dollars to the building fund, and in addition he made a conditional subscription of five thousand dollars to the same fund. These facts are cited in evidence of Mr. WILSTACH's interest in the progress of 1870.]

Science and culture;—they are among the reasons why the Academy recognizes in his death the loss of a liberal patron, a judicious counsellor and an agreeable associate.

Resolved, That this expression of the Academy's appreciation of Mr. WILSTACH's worth be communicated to his widow and family, in token of its sympathy with their bereavement.

(Signed)

S. B. HOWELL, Rec. Sec.

W. S. W. RUSCHENBERGER,

JOS. LEIDY,

WM. S. VAUX.

The following gentlemen were elected members of the Academy: Green Smith, Thos. Stewardson, H. Weir Workman, W. B. Rogers, Thos. G. Gentry, Wm. H. Pancoast, M. D.

The following were elected correspondents: Prof. Igino Cocchi, of Florence, Italy; Prof. John Jas. Stevenson, Ph. D., of Morgantown, W. Va.

On favorable report of the Committees, the following papers were ordered to be published:

Notice of some Crustacea of the Genus LIBINIA, with descriptions of four new Species.

BY T. HALE STREETS.

Much uncertainty has existed with regard to the identity of certain species belonging to the genus *Libinia*. *Libinia dubia*, ever since it was first established by Milne Edwards, has been regarded as a doubtful species. In the description of it by Edwards, he states that it resembles *L. canaliculata* very much, and that it is not improbable that it is the young of that species. Naturalists in this branch of science down to the present time appear to have accepted this statement as the truth.

De Kay, in his Natural History of New York, states that the "younger individuals, 1—4 in. in length, are more pyriform in shape, are entirely covered with a dense, downy hair, and the spines are not so prominent as in the adult. In this state I suppose it to be the *L. dubia* of Edwards."

Gibbes in an article in the Proceedings of the American Association for 1850, regards the two species as distinct, but says that no absolute characters can be indicated by which they may be separated.

I do not know how to account for this prevailing ignorance, as the characters existing, separating the two species, are so plain.

LIBINIA DUBIA, Edwards. His. Nat. des Crust. vol. 1, p. 300, pl. 14, fig. 2.

L. distincta, Guérin.

Besides the characters usually given as distinguishing this species, the following may be observed, and they will be found to be highly characteristic.

In the median line of the body, counting backward from the depression separating the gastric and genital regions, there is a row of four spines; one on the genital region, two on the cardiac and one on the intestinal. One small spine on the posterior part of the gastric region in the median line, and five arranged transversely on the anterior part of the same region. Three prominent spines on the branchial region independently of those on the lateral margin. The *hepatic region* is usually devoid of spines or tubercles; sometimes there is a very small, sharp one on each side, or, again, it may be present on one side and absent on the other. There is never more than one on a side. The regions are very distinctly marked out.

Rostrum prominent. Its bifurcated extremity diverging, and directed nearly horizontally. The cleft deep.

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Habitat. Common species of the Southern Atlantic coast. Very common in the Delaware Bay. In the Academy's collection are four specimens from the coast of Long Island; and one from West Africa, by Duchailu.

LIBINIA CANALICULATA, Say. Jour. Acad. Nat. Sc. vol. 1, p. 77, pl. 4, fig. 1.

L. emarginata, Leach.

In the median line of the body, counting backward from the depression separating the stomach from the genital region, there is a row of five spines; one in the genital region, two in the cardiac and two in the intestinal. On the gastric region there is a longitudinal row of four spines. The second one counting from behind forward is generally double. The anterior one is situated in front of the transverse row, which contains four spines or tubercles, two on each side. The hepatic region always presents more than one spine, usually three, sometimes more; sometimes three on one side and two on the other. One large spine situated on the posterior part of the branchial region, on a line with the lower spine on the intestinal region, another smaller one intervening between. The whole surface of the carapax studded over with numerous spines and tubercles arranged more or less regularly. The spines on the lateral margin not as prominent as in *L. dubia*, but of the same number.

The cleft of the bifurcated extremity of the rostrum is very shallow. The teeth of the rostrum not on the same plane as in *L. dubia*, they present a direction downward. In the largest specimens the anterior extremity is considerably hooked.

The characters here enumerated as distinguishing *L. canaliculata* will be found to hold good through all variations of size—in those that are no more than an inch in length, as well as in those that are from four to five inches long, the latter being the largest of the kind that I have ever seen.

Habitat. Common to the North Atlantic coast, but extends down to the West Indies.

LIBINIA AFFINIS, Randall. Jour. Acad. Nat. Sc. vol. VIII, p. 107.

Gibbes says of this species that it "so closely resembles *L. dubia*, that if from the Atlantic coast, I should not regard it as different, but as it comes from Upper California I cannot venture to pronounce it the same."

The author here quoted undoubtedly made a mistake when he said that *L. affinis* closely resembles *L. dubia*. Stimpson approached the truth more nearly when he stated that "it is very closely allied to *L. canaliculata*." It is undoubtedly nothing more than the young of *canaliculata*. That it is so will be evident to any one who will take the trouble to compare them closely. It agrees with *L. canaliculata* in every respect excepting size.

LIBINIA SUBSPINOSA, Streets, n. s.

Carapax pyriform. Regions distinct. Spines and tubercles few. Three small tubercles arranged transversely on the anterior portion of the gastric region, one on the median line and one on each side. On the posterior part of the stomach, in the usual situation of a spine or tubercle, there is a slight elevation. Genital region compressed from before backward. Two spines on the cardiac region, and one, rather large, on the intestinal region. Five spines on the lateral margin of the branchial region; the posterior one large. On the upper portion of the same region, near the superior border, are two more, arranged in a line from before backward. Hepatic region devoid of spines, smooth. Just beneath this region, on the antero-lateral border, are two spines, the anterior one large.

Rostrum prominent; teeth short and their apices directed forward and toward each other. A short obtuse spine projecting over the inner canthus of the eye. On the inferior border of the orbit are two small tubercles. External antennæ cylindrical.

Anterior pair of feet shorter than the second. The fingers come in contact

along half the extent of their denticulated margins. The second pair of feet about the same length as the carapax, rostrum included.

The surface covered with close, short hair. Length of the body to the tip of the rostrum one inch and a half.

Habitat.—Chili.

(Cabinet Phila. Acad. Nat. Sci.)

LIBINIA RHOMBOIDEA, Streets, n. s.

Carapax nearly circular. Regions distinct; those in the median line of the body flattened. Six small but sharp spines on the gastric region; five arranged transversely on the anterior part. The two outer ones and the middle are larger, and are placed in a direct line with one another; the two intervening ones are smaller, and are situated a little in front of the others. One spine situated on the posterior part of the stomach. All the spines on the central regions small. Genital region quadrilateral and bearing a small spine. One on the cardiac region and one on the intestinal. On the posterior part of the cardiac region is an elevation which presents a depression in its summit. Four large and sharp spines on the branchial region independently of those on the lateral margin. These are placed so as to inclose a rhomboidal-shaped figure between them. A prominent spine on the hepatic region; five on the lateral margin. These with the one on the hepatic region form nearly half a circle. Below the lateral row anteriorly are two prominent spines.

A prominent spine above the inner canthus of the eye; a small one at the external canthus. External antennæ cylindrical. A spine situated to the outer side of them, and one beneath directed downward.

Rostrum not so broad as in *L. dubia*, and its bifurcation less divergent, the teeth being directed nearly horizontally forward. Anterior pair of feet short and granular; a short spine on the lower portion of the arm. Second pair of feet nearly one and a half times as long as the body. Length of the body three inches and a half.

Habitat.—East Indies.

(Cabinet Phila. Acad. Nat. Sci.)

In the Academy's collection is a single specimen, which very much resembles the preceding, and in the absence of any others of the same kind to confirm the characters, I will not venture to call it a new species. The following are the chief points of difference. The regions in the median line of the body less depressed. The transverse row of spines on the anterior portion of the gastric region are arranged somewhat differently. The two lateral ones on each side are placed in a direct line, while the middle one is situated a little posteriorly. The bifurcation of the rostrum is more divergent and the teeth are inflated to their tips. Second pair of feet but little longer than the body. Length of the body two inches and four-fifths.

Habitat.—West Indies.

If this should prove a new species, I propose for it the name of *Libinia inflata*.

CHIONOCETES CHILENSIS, Streets, n. s.

Body very much depressed, flattened on top; nearly as broad as long. Posterior border rounded; broad anteriorly. Anterior and middle portions of the carapax covered with small wart-like prominences, which are depressed. These terminate in a more or less well-defined line drawn transversely through the centre of the cardiac region. All that portion of the surface not covered with prominences, granular. Regions not very distinct; gastric region somewhat triangular. External angle of the orbit projecting. Rostrum very short, and flattened. Eyes large, of a brown color with black spots.

Anterior pair of feet but little longer than the body. Internal and external borders of the under surface of the arm minutely spinous. These as well as the other feet granular. Fingers long and slender, more than half the length

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of the whole hand; denticulated along the whole length of their approximated margins. The third article of the second pair of feet flattened; that of the third pair less so. The same article of the fourth pair nearly cylindrical; that of the fifth pair cylindrical. This article is long, straight and inflated; largest diameter in the middle, gradually tapering anteriorly; no enlargement at the nodes. Hair on the body very short, scarcely discernable. Length of body about one inch.

This species can very readily be distinguished from *Peloplustus* (*Chionoecetes*) *Pallasi*, Gerstæcker. Unlike this the upper surfaces of the tibiæ are not covered with short spines, and the double row of granules is wanting on the tarsi.

C. Chilensis may be distinguished from *C. Behringianus*, Stimpson, by the wart-like prominences not increasing in acuteness anteriorly and at the sides, except at the inferior antero-lateral margin. Here, instead of there being fourteen small bifid spines as in *C. Behringianus*, there are but eleven or twelve; the first five or six only being of any size. The third articles granular below as well as above. Only the inferior angles of the arms of the first pair of feet are muricated.

Habitat.—Chili.

(Cabinet Phila. Acad. Nat. Sci.)

HUENIA BIFURCATA, Streets, n. s.

Carapax smooth, elongated, narrowing in front. Antero-lateral margins acute. On the gastric region three low tubercles arranged in a triangular form with the base of the triangle directed forward. A low tubercle on the cardiac region. The antero-lateral borders produced into sharp processes, directed forward, outward and slightly upward from the base of the rostrum. Rather broad lateral projections at the junction of the antero-lateral and postero-lateral borders, directed somewhat upward. These projections present two teeth at their extremities, separated by a concave interval. Postero-lateral borders rounded. Posterior border projecting backward lip-like, slightly everted on each side.

Rostrum about two-tenths of an inch in length; bifurcated at its point; flattened horizontally at the anterior extremity, which is on a lower plane than the base. Upper surface covered with hooked hairs. Under surface of the rostrum concave.

Eyes small, slightly projecting from under the lateral borders of the carapax. External antennæ slender and completely concealed under the anterior prolongation. Basal article cylindrical, slightly clubbed at its anterior extremity; the second article more than half the length of the first; the third very delicate.

Anterior pair of feet about the same length as the carapax. On the distal extremity of the upper surface of the third article is a small tooth directed forward. Second pair of feet longer than the first pair,—about one inch in length. The following feet considerably shorter, and each presents a spine at about the middle of the under surface of the fifth article. Carapax, rostrum included, nine-tenths of an inch in length.

Habitat.—New Zealand.

(Cabinet Phila. Acad. Nat. Sci.)

On the Flowers of *ARALIA SPINOSA*, L., and *HEDERA HELIX*, L.

BY THOMAS MEEHAN.

The study of *Aralia spinosa*, L., affords some interesting facts which do not seem to have attracted the attention of other observers.

In Dr. Gray's indispensable *Manual of Botany*, it is said to be "more or less polygamous." I have had many specimens under my daily observation 1870.]

this season, from the earliest opening till the last blossom appeared, and find that it is much more nearly monœcious than the above quotation would imply.

There are three different sets of flowers corresponding to the thrice compounded branchlets of the large panicle. When the flower scape elongates, it seems suddenly arrested at a given point, and a very strong umbel of female flowers appears at the apex. A great number of secondary branches appear along this main one; and they also suddenly terminate each with an umbel of female flowers. From these secondary branches a third series appear, and these flowers are well filled with anthers that are abundantly polleniferous. The female organs of these flowers of the third class, are, however, defective, as only a few bear capsules, and in these, a large portion of the seeds have no ovules. The polygamous character is confined to this third series of flower, the first two having purely pistillate blossoms. In these there do not seem to be the rudiments of stamens.

The most remarkable part of this process of development is, that the whole of this first series of female flowers should open so long before the male ones come, that they fall unfertilized. Most part of the second series also fall, and the crop of seeds is mainly made up of a few of the last opening ones of the section, and the comparatively few hermaphrodite ones which are found in those of the third class. It is a matter for curious speculation what special benefit it can be to the plant to spend so much force on the production of female flowers too early to mature, and then producing such an immense mass of pollen to go utterly to waste.

It may not be amiss to note, that in the common carrot the earlier strong umbels have often a male flower in the center; and that while the usual flowers are of a pure white, this one is of a crimson color. In the central umbels of *Aralia spinosa*, and at times on spurs along the branchlets of the panicle are similar colored processes, so small that their form cannot be made out by a common pocket lens. Our fellow member, Dr. J. Gibbons Hunt, makes them out, under the dissecting microscope, to be vase-like forms with five minute reflexed segments, and with a small solid disk in the centre. It is interesting as evidently being a successful attempt of an abortive flower to simulate in some respects a real one of another character.

Examining, also, the flowers of the allied European Evergreen Ivy, *Hedera Helix*, L., I find similar laws of distribution of the sexes as in *Aralia spinosa*, with the addition of a somewhat different structure in the male from the female flowers.

In Europe the plant is described as often having a single umbel as a flower spike. It is quite likely in these cases the flowers are hermaphrodite. In all the cases I have met here, the inflorescence is a compound of several umbels,—a terminal one—female, and the lateral ones male, as in *Aralia*. But there are rudiments of stamens in the flower, and in occasional instances I find a filament developed; but never, so far, with any polleniferous anthers. The flowers of the central female umbel have rather longer and stronger pedicels than the lateral male ones. The calyx is united with the ovary for one-half its length, and the latter much developed in the unopened flower. In the male the segments of the calyx are two-thirds free, and the petals are much longer than in the female flowers.

As in *Aralia spinosa*, the male flowers do not open until some time after the female ones; and not before some of the latter, impatient of delay, have fallen unfertilized.

I have so often and in so many varied ways demonstrated to the Academy that in plants the male element is a later and inferior creation, that it seems almost superogatory to point out that these plants illustrate the same principle. But it is part of the record of what I believe to be unobserved facts in relation to these species, therefore I briefly allude to them.

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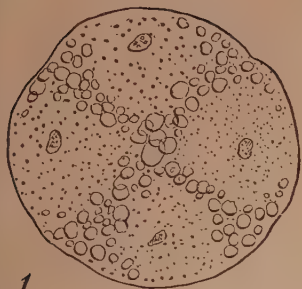
(*From the American Naturalist, February, 1880.*)

THE DEVELOPMENT OF MOINA.¹

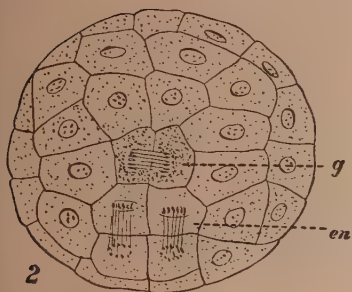
BY J. S. KINGSLEY.

DR. Carl Grobben having recently published one of the most complete accounts of the development of one of the Daphnidæ which has yet appeared, an abstract of his paper may prove of value to American naturalists.

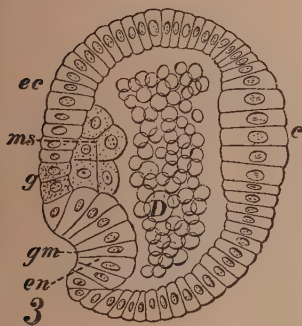
¹ Die Entwicklungsgeschichte der *Moina rectirostris*. Arbiten aus dem Zoologischen Institute der Universität. Wien. Tom. II, 2 heft, 1879, pp. 66, pls. 7.



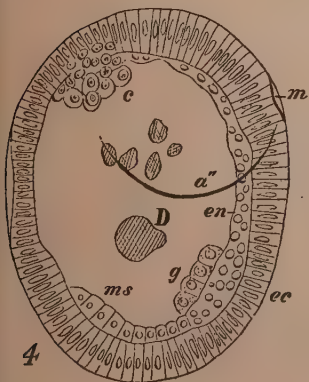
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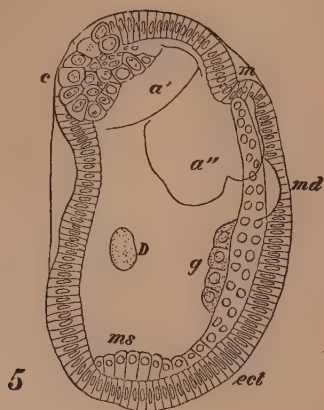
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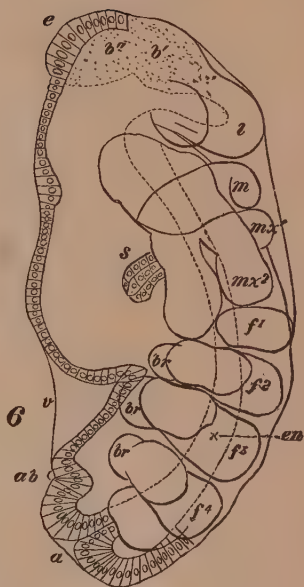
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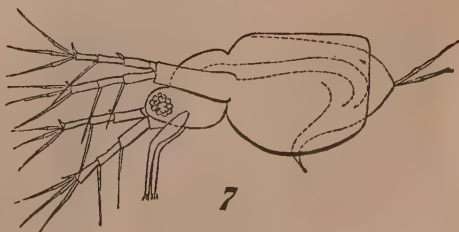
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The eggs of *Moina* are oval and measure about one-tenth of a millimetre in length. Segmentation occurs first on the minor and then on the major axis, thus producing four cleavage spheres. A polar view of these is shown in Fig. 1, the food granules (*deutoplasm*) being seen between the blastomeres. Another division produces eight segments, but after this, cleavage takes place at unequal rates in different parts of the egg. As we understand the matter, these cleavage planes do not all pass completely through the yolk. In the resulting mulberry stage the "genital cell" (which afterwards produces the genital system) is differentiated even before the first signs of the gastrula stage. (Fig. 2 *g*, genital cells or the cells which by invagination produce the endoderm. In these cells the so-called *Amphiaster* is shown.) Soon there begins an invagination of the endodermal cells, and other cells arise beneath the ectodermal cells near the genital cells. These form the mesoderm. Others, opposite the genital cells, are larger, and these form the cephalic germinal plate, "scheitel platte." (Fig. 3, an optical section; *ec*, ectoderm; *ms*, mesoderm; *g*, genital cells; *gm*, gastrula mouth; *en*, the cells which form the endoderm; *c*, cephalic germinal plate; *D*, deutoplasm.) Then the gastrula mouth closes up, the genital and endodermal cells become internal, the body is constricted and a fold is formed on either side, the first indication of appendages, which develops into the second antennæ. A depression occurs in the ectodermal cells, where finally the mouth appears. (Fig. 4, lettering as before; *a''*, second antennæ; *m*, depression for mouth.) In the next phase two more appendages have budded, the antennulæ and mandibles, while the antennal bud becomes two-lobed. This constitutes the nauplius stage. (Fig. 5, *a'*, antennulæ; *md*, mandible.) Next, two of the thoracic feet are indicated, then two more, the brain begins to appear, the mouth depression is deeper, the anus is indicated and the genital cells divide and are placed on each side of the median line. Then the maxillæ and the fifth pair of feet appear; the eye begins to be developed from the ectodermal cells, the shell gland is present and the abdominal bristles are outlined. (Fig. 6, *b'* *b''*, brain; *mx*¹ *mx*², first and second maxillæ; *f*¹–*f*⁵, thoracic feet; *br*, branchial sacs; *ab*, abdominal bristles; *a*, anus; *s*, shell gland; *v*, vitelline membrane; other letters as before.) The succeeding changes are those of increase in size of the appendages, in which joints appear, the formation of the shell, appearance of heart and the covering of the eye, and at last the animal acquires the perfect form (Fig. 7, from Baird).

With the authors' comments
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ON THE
CLASSIFICATION
OF THE
MAIROID CRUSTACEA OR OXYRHYNCHA,
WITH A
SYNOPSIS OF THE FAMILIES, SUBFAMILIES, AND GENERA.
BY
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On the Classification of the Maioid Crustacea or Oxyrhyncha,
with a Synopsis of the Families, Subfamilies, and Genera.
By EDWARD J. MIERS, F.L.S., F.Z.S., Assistant in the Zoo-
logical Department, British Museum.

[Read March 6, 1879.]

(PLATES XII. and XIII.)

INTRODUCTORY REMARKS.

THE Oxyrhyncha, or Maioid Crabs, have been placed by nearly all carcinologists at the head of the Brachyura, on account of the high degree of concentration exhibited both in the sensory organs and nervous system. There is perhaps no one of the great divisions of the higher Crustacea more numerous in genera and species, or more interesting on account of the great variety both of form and structure exhibited in the different types, nor any in which a thorough revision of the classification is more urgently needed.

No comprehensive account of the group has appeared since the

publication, in 1834, of Milne-Edwards's first volume of the 'Histoire naturelle des Crustacés,' wherein 36 genera of this group are enumerated.

Dana, in 1852, in his account of the Crustacea of the U.S. Exploring Expedition, gives a synopsis of the then known genera, the number of which had considerably increased. Since that time, however, no further revision has appeared; but during the twenty-six years that have elapsed, a very considerable number of new forms have been made known to science, through the labours of modern carcinologists, among whom the late Dr. Stimpson and M. Alphonse Milne-Edwards must be particularly mentioned. The total number of well-established genera included in the present revision is 106; but not a few of those previously described are reduced to the rank of subgenera or are regarded as synonyma, and others, which are insufficiently known to me, are referred to parenthetically.

The Oxyrhyncha, as defined by M. Milne-Edwards, constitute as a whole a natural group; but no single character can be mentioned which will serve to distinguish them universally from the other Brachyura. Externally they are distinguished by their more or less elongated carapace (which is usually provided with a rostrum and narrows anteriorly), large epistoma, longitudinal antennules, and the position of the basal antennal joint, which in the typical Maiidæ is situated beneath the eyes. The buccal cavity is quadrate, with its anterior margin straight. The branchiæ are nine on each side, the afferent canal opens behind the pterygostomian regions in front of the anterior legs, and the efferent canal at the sides of the buccal cavity. The male genital appendages arise from the bases of the fifth ambulatory legs.

From the Oxystomata, which are closely related to the Oxyrhyncha in the narrowness of the frontal region and the concentration of the organs of sense, the latter are distinguished by the triangulate buccal cavity and the position of the afferent branchial channel; but the genus *Mesorhæa*, recently described by Stimpson, evinces a remarkable approximation on the part of the Parthenopidæ to the Oxystomatous type. From the Cyclometopa (Caneroid Crabs) the typical Maiidæ are distinguished by the longitudinal antennules and the position of the basal antennal joint; but the Parthenopidæ, again, occupy in this respect a position almost intermediate between the rest of the Oxyrhyncha and

certain Cancroidea. They may indeed be regarded as not so much true Oxyrhyncha as a group osculant between these latter and the Cancroidea and Oxystomata.

Nearly all subsequent authors have retained the Oxyrhyncha as defined by Milne-Edwards. Dr. Strahl, however, in a system of classification of the Brachyura* based mainly upon characters afforded by the structure of the basal joint (*basicerite*) of the antennæ, separates the Parthenopinæ from the Oxyrhyncha, and unites them with the Calappidæ and Matutidæ, which he removes from the other Oxystomata, and places *Oncinopus* in the vicinity of the Grapsoid genus *Hymenosoma*. His views were shortly afterwards adversely criticised by Stimpson†, who demonstrated the inconvenience of a classification founded upon the modifications of a single organ, and necessitating the dismemberment of the older natural groups, and instanced several genera which would thereby be removed from the place in the system to which their real affinities would assign them; nor do I believe Dr. Strahl's views have been adopted by any later carcinologist.

As regards the primary subdivisions of the Oxyrhyncha, the following are the principal classifications that have been proposed.

Milne-Edwards in 1834‡, divided the Oxyrhinques (Oxyrhyncha) into three tribes or primary groups of equal value. The first two of these, his Macropodiens and Maïens, are distinguished merely by the greater length of the ambulatory legs of the former group, in which are placed all those forms in which the first and second ambulatory legs are longer than the anterior legs and more than twice as long as the postfrontal portion of the carapace. If this distinction were rigidly applied, it would be necessary to place not only nearly-allied genera, but species of the same genus (e. g. *Doclea*) in different families. Yet it is not to be denied that the greater length of the ambulatory legs is often correlated with important modifications of the structure of the orbits and antennæ.

- Milne-Edwards's third group, Parthénopiens, is a perfectly natural

* Monatsber. Akad. Wissensch. Berlin, pp. 713 and 1004 (1861).

† Amer. Journ. Sci. and Arts, vol. xxv. p. 139 (1863).

‡ Histoire naturelle des Crustacés, vol. i. p. 272 (1834).

one, and has been adopted by nearly all later authors, and constitutes the fourth family, Parthenopidæ, of the present revision. The genera included in his Macropodiens are, with a few exceptions (*Latreillia*, *Egeria*, *Doclea*), included in my subfamilies Leptopodiinæ and Inachiinæ. The primary sections of his Maiens (*M. cryptophthalmes* and *M. phanérophthalmes*) although somewhat differently characterized, correspond, the former (with the exception of *Libinia*, *Lissa*, *Mithrax*, and *Chorinus*) to my family Maiidæ; the latter, except *Pericera*, *Paramicippa*, and *Stenocionops*, to the subfamily Acanthonychinæ of my family Inachidæ.

De Haan, in the fourth decade of his great work*, divides his family Majacea into five primary groups, or "genera," i. e. *Parthenope*, *Maja*, *Pisa*, *Doclea*, and *Inachus*. The first of these corresponds to my family Parthenopidæ, *Æthra* being rightly included and *Eurynome* omitted from the group. The three following are characterized only by the form of the merus joint of the outer maxillipedes (a most variable character); and the genera (or "subgenera" as they are designated by De Haan) are grouped together in each without reference to the orbital and antennal characters: consequently these groups are in no degree conterminous with those adopted in the present revision. The fifth, or *Inachus* group of De Haan, includes those genera which are characterized by the articulation of the merus joint of the outer maxillipedes with the next at its summit instead of its antero-internal angle. This is a far more natural section; yet the rigid application of this character would now necessitate the separation of genera very closely allied in other respects, as Dana has shown in the case of *Eurypodius* and *Oregonia*; and other instances might be given.

In Dana's arrangement of the Maioidea†, three legions or primary sections are established. The first (Maiinea) corresponds to the Macropodiens and Maiens of M.-Edwards, and is divided into five families; the second (Parthenopinea) corresponds to M.-Edwards's Parthénopiens; and the third (Oncininea) is established for the single genus *Oncinopus* of De Haan.

The characters of the families of the Maiinea are tabulated as follows:—

* Crustacea of the 'Fauna Japonica' of V. Siebold, p. 77 (1839).

† Amer. Journ. of Sci. and Arts (ser. 2), xi. p. 425 (1851), and U.S. Explor. Exped. xiii. Crust. i. p. 77 (1852).

Fam. i. MAIIDÆ. Eyes retractile into orbits.

Fam. ii. TYCHIDÆ. Eyes retractile beneath carapace; no orbits.

Fam. iii. EURYPODIDÆ. Eyes retractile to sides of carapace.

Fam. iv. LEPTOPODIDÆ. Eyes not retractile. Legs very long.

Fam. v. PERICERIDÆ. Eyes not retractile. Legs of moderate length.

With respect to this arrangement I may observe, in the first place, that the retractility or non-retractility of the eyes is scarcely a character that can be used for separating the families; for in many of the Leptopodiidæ the eyes are capable of a certain degree of mobility, and in many Periceridæ they are, as Stimpson has pointed out, completely retractile within the orbital cavity. It is somewhat remarkable that Dana did not observe the characters that are afforded by the structure of the orbital region itself, taken in conjunction with the concurrent modification of the form of the basal antennal joint, to which attention had already been drawn by Milne-Edwards, and which, I am convinced, offer far better distinctions for a natural arrangement of the various groups. Within his first family (Maiidæ) Dana includes most of the genera referred by me to the Maiidæ and Periceridæ; his second family (Tychidæ) contains but three genera, whereof the last, *Camposcia*, has but little affinity with the two preceding; the third (Eurypodidæ) also includes but three genera, all referable to my family Inachidæ; the fourth (Leptopodidæ) corresponds, with the exception of *Inachoides*, to my subfamily Leptopodiinæ. The fifth (Periceridæ) is a somewhat heterogeneous group; but the majority of the genera included in it belong to my subfamily Acanthonychinæ of the family Inachidæ.

The subfamilies of the Maiinea instituted by Dana appear to me to be unnecessarily numerous, and are for the most part founded upon characters of minor importance, *i.e.* the form of the carapace and rostrum. His minor subdivisions, indeed, are less natural than those of Milne-Edwards; but to him belongs the merit of having recognized that the Parthenopinea form a group equal in value to the remainder of the Oxyrhyncha (with the single exception of *Oncinopus*).

M. Alphonse Milne-Edwards, by whose finely illustrated memoirs our knowledge of the genera of Oxyrhyncha has been so greatly increased, has not, I believe, published any classification of the group; but in his classification of the Brachyura set forth in the introductory portion of his 'Histoire naturelle des Crustacés

fossiles'*, establishes two families, Inachœidiens and Maiens, apparently corresponding to Dana's Maiinea and Parthenopinea.

The late Dr. Stimpson, in his Preliminary Report of the Crustacea Brachyura dredged in the Gulf Stream †, points out several errors in Dana's classification, and proposes or amends the characters of several subfamilies and families. Of these the Pericerinæ, Othoniinæ, Eurypodiidæ and Acanthonychidæ would seem to correspond respectively to my Periceridæ, Othoninæ, Inachidæ and Acanthonychinæ; but as often only a single character is mentioned by which to distinguish the groups, and no lists of the genera included are given, the limits he would have assigned to them had he lived to publish a complete system must remain uncertain. His subfamilies Leptopinæ and Collodinæ are not retained in the present classification.

It may be useful in conclusion to refer to the arrangement adopted by Dr. Claus in his lately-published Treatise on Zoology (Grundzüge der Zoologie, 3te Aufl. p. 558, 1876), as, although this author does not do more than indicate the leading generic types of the Oxyrhyncha, his views are of special interest as emanating from a carcinologist of the highest reputation. In his system the Oxyrhyncha are divided into two families—Majidæ, Parthenopidæ—corresponding to the first and second of Dana's legions; and the Majidæ are further subdivided into three subfamilies:—(1) Majinæ, in which the eyes are retractile into orbits; (2) Eurypodinæ, in which the eyes are retractile but without orbits; and (3) Leptopodiinæ, with non-retractile eyes.

In the present revision the first and second of Dana's primary groups (Maiinea, Parthenopinea) are retained. The remarkable genus *Oncinopus*, for which Dana established a section (Oncininea) equal in value to the two above mentioned, must, I believe, be included in my family Inachidæ. The abbreviated character of the basal antennal joint is not peculiar to it, but exists also in *Macrocheira*; the genus, however, exhibits a certain degradation from the Brachyura in its subdorsally raised fifth ambulatory legs. In its antennal characters, no less than in the flattened triangulate form of the carapace, it approaches the Grapsoid genus *Elamene* and its allies.

* Ann. Sci. Nat. tome xiv. Zoo', p. 185 (1830).

† Bulletin of Museum of Comparative Zoology, ii. p. 109 (1870).

Within the *Mainea*, a regular gradation of characters may be traced from the forms (*Leptopodia* and *Stenorhynchus*) with non-retractile and laterally projecting eyes and narrow basal* antennal joint and elongated epistoma, at one end of the series, to those (exemplified in *Pericera* and *Mithrax*) with deep circular and well-defined orbits, transverse epistoma, and greatly developed basal antennal joint, at the other; and I accordingly distinguish among the *Mainea* three principal groups, founded upon the orbital and antennal characters, as will be seen in the following tabular arrangement.

Legion I. MAINEA. (*Mainea*, Dana; *Inachoidiens*, A. M.-Edwards.)

Basal antennal joint well developed, inserted beneath the eyes, and occupying a great part of the infraocular space.

Family I. INACHIDÆ. Eyes non-retractile, or retractile against the sides of the carapace. No defined orbits exist; but there is often a well-developed præocular or postocular spine. Basal joint of antennæ usually very slender, sometimes moderately enlarged.

Family II. MAIIDÆ. Eyes retractile within the projecting orbits, which are more or less incomplete below the eyes, or marked with open fissures in their upper or lower margins. Basal antennal joint always more or less enlarged.

Family III. PERICERIDÆ. Eyes usually retractile within the orbits, which are small, deep, and circular, never incomplete. Basal antennal joint well-developed, and usually very considerably enlarged.

As a rule, there can be no difficulty in assigning to any genus its place in one or other of the three families characterized above; yet, as the Maiidæ constitute a group intermediate between the Inachidæ and Periceridæ, there are certain genera which lie on the border line separating the Inachidæ and Maiidæ, which might be referred with almost equal justice to either family unless some artificial limit were imposed. In *Loxorhynchus*, for example, the præocular and postocular spines and basal antennal joint are largely developed, and this genus approximates closely in its orbital and antennal characters to *Pisa* and its allies among the Maiinæ; and, to take another instance, *Tyche* has its upper orbital margin as much developed as *Acanthophrys* among the Maiidæ, yet cannot be separated from its natural allies *Stenocionops* and *Stilbognathus*, which belong to the Inachidæ. Again, among the *Mainea* with deflexed front, it will be shown that a regular transi-

* I use this term, in the sense commonly employed by authors, for the large joint which is apparently the first of the basal portion of the antennæ, but is in reality the second joint ("basicerite").

tion may be traced from *Micippa* with well defined orbits, to the remarkable genus *Picrocerus*, in which the true orbits are as little developed as in many *Inachinæ*.

In cases such as these, I believe it is often better to preserve the natural sequence of the genera, though in so doing one must slightly overstep the literal definition, than, by too strict an adherence to the definition of the group, to separate forms which in all characters save one may be nearly allied. Nature imposes no artificial limits; and not even an arbitrary distinction will in all cases avail to separate kindred forms*.

Legion II. PARTHENOPINEA. (*Parthenopinea*, Dana et auctorum).

Basal antennal joint very small, and embedded with the next joint in the narrow hiatus between the front and inner suborbital angle; the infraocular space being mainly occupied by the lower wall of the orbit.

Family IV. PARTHENOPIDÆ. Characters of the section:—This group corresponds in the main with M.-Edwards's *Parthénopiens*; but the characters are modified to include several genera which agree with those known to Milne-Edwards in the structure of the orbits and antennæ, but differ in the carapace and anterior legs. Moreover I follow De Haan in excluding *Eurynome* (which really belongs to the *Maiidæ*) and including *Æthra* (which is placed by Milne-Edwards in a separate section of the *Cancériens*—*Cancériens cryptopodes*).

As already stated, the *Parthenopinea* are very distinct as a group from the rest of the *Oxyrhyncha*. Perhaps their nearest affinities in that direction are with *Inachus* through *Inachoides*. The triangulate form of the carapace, with its strongly marked depressions separating the different regions, is the same, and the slender basal antennal joint. In *Inachoides* the rostrum is simple, as in *Parthenope* and *Lambrus*.

In the plates that accompany this paper I have figured what may be regarded as typical examples of the principal modifications in the structure of the orbital and antennal region throughout the *Oxyrhyncha*, wherein may be traced the gradual

* Dana, for example, separated the *Cancroidea* into two parallel groups (*Cancridæ* and *Eriphiidæ*), characterized respectively by the presence or absence of a ridge on the endostome defining the efferent branchial channel; but in *Xanthodius*, a genus since described by Stimpson, this ridge is rudimentary, and this genus may be referred either to the vicinity of *Chlorodius* in the former, or *Ozius* in the latter group. Similar intermediate forms occur between *Actæa* and *Actæodes*, genera belonging respectively to the parallel series *Xanthinæ* and *Chlorodiinæ* in the family *Cancridæ*.

approximation of the Maioid to the Cancroid type through the development of the orbits and of the basal portion of the antennæ, the increase in width of the interocular portion of the carapace, the shortening of the epistome, and the obsolescence of the rostrum.

In the synoptical arrangement of the families, subfamilies, and genera which follows, I have omitted all references to the literature, as these will, it is hoped, be given on a future occasion, and the characters themselves are to be regarded as merely diagnostic. Those genera which are unknown to me from examination of specimens are distinguished by an asterisk; and it may be, as the descriptions are often short and insufficient, that I have referred one or two to a wrong position in the system. Synonyma are placed in brackets and printed in *italics*. In every case I have cited what I regard as the typical species of the genus. Many of the genera are distinguished by characters of very trivial importance; and it is impossible in any linear arrangement to express adequately their very complex affinities; but is hoped that the present arrangement, while on the whole a natural one, will serve as a practical guide to the determination and classification of the numerous types of this interesting group.

SYNOPTICAL ARRANGEMENT OF THE FAMILIES, SUBFAMILIES, AND GENERA.

Family I. INACHIDÆ.

Eyes non-retractile, or retractile against the sides of the carapace. No defined orbits exist; but there is often a well-developed præocular and postocular spine. Basal joint of antennæ usually slender, sometimes moderately enlarged.

The carapace varies in shape, being subtriangular, or oblong-triangular, or subpyriform. Rostrum simple or bifid, sometimes very short. Anterior legs with the fingers never excavated at the tips. Ambulatory legs sometimes very long. Postabdomen of male and female 4- to 7-jointed, two or three of the joints often coalescent.

Subfamily 1. LEPTOPODIINÆ. (See Plate XII. figs. 1, 2.) (*Macropodiens*, M.-Edwards, part.; *Leptopodidæ*, Dana, part., Stimpson.)

Eyes slender, non-retractile, and laterally projecting. Præocular and postocular spines minute or wanting. Basal antennal joint very slender throughout its length.

The carapace is subtriangular. Rostrum usually simple (bifid in *Stenorhynchus*). The merus joint of the outer maxillipedes is truncated, or elongated and rounded at its distal end, and articulated with the next joint at its summit or at its antero-external or antero-internal angle. The anterior legs have the palm cylindrical or inflated, fingers acute. Ambulatory legs slender and very long.

The genera included in this subfamily are placed at the head of the Maioidea on account of the close approximation of the eyes and antennæ and their separation from the rest of the body by the constriction of the postocular portion of the cephalothorax; the epistome is very long, and generally two or three of the post-abdominal segments coalescent.

§ *Rostrum extremely long, simple. A postocular spine. Anterior legs with the palm elongated, cylindrical. Ambulatory legs extremely long.*

LEPTOPODIA, *Leach* (*Macropus*, Latr., part.; *Pactolus*, Leach). Carapace smooth, even above. Antennæ concealed beneath the rostrum. Type *Leptopodia sagittaria* (Fabr.).

* METOPORAPHIS, *Stimpson*. Carapace uneven above. Antennæ long, flagellum exposed. Type *Metoporphis calcarata* (Say).

§§ *Rostrum composed of two spines, or very short and simple. No postocular spine. Anterior legs with the palm shorter, inflated.*

STENORHYNCHUS, *Lamarch* (*Macropus*, Latr., part.; *Macropodia*, Leach). (Plate XII. figs. 1, 2.) Rostrum elongated, of two slender contiguous spines. Type *Stenorhynchus rostratus* (Linn.).

ACHÆUS, *Leach*. Rostrum very short, emarginate. Type *Achæus Cranchii*, Leach.

The characters derived from the form of the merus joint of the outer maxillipedes and dactyli of the ambulatory legs are subject to much variation in the exotic species.

* PODOCHELA, *Stimpson*. Rostrum simple, acute. Pterygostomial regions naked. Type *Podochela grossipes*, Stimpson.

PODONEMA, *Stimpson*. Rostrum simple, rounded, excavate beneath, and hood-shaped. Pterygostomial regions with lamelli-

form ridges defining the afferent branchial channels. Type *Podonema Rüsei*, Stimpson.

Subfamily 2. *INACHINÆ*. (See Plate XII. figs. 3, 4.) (*Macropodiens*, M.-Edwards, part.; *Eurypodiidæ*, Stimpson.)

Eyes slender and retractile. Præocular spine usually wanting, postocular usually distinct. Basal antennal joint usually very slender throughout its length, not narrowing distally.

The carapace is subtriangular or subpyriform; its margin is often slightly produced over the base of the eye-peduncles. Rostrum simple, bifid, or two-spined. The merus joint of the outer maxillipedes is either truncated and articulated with the next joint at its antero-internal angle, or elongated and rounded at its distal end. The anterior legs in the male are small, or have the palm inflated and the fingers acute. The ambulatory legs are usually slender, and often very long. Postabdomen 5- to 7-jointed.

In this subfamily are included what may be considered the typical *Inachidæ*. The form of the merus joint of the outer maxillipedes would probably afford excellent sectional characters; but as many of the genera are unknown to me, I prefer to group them according to the form of the rostrum.

§ *Rostrum very short, emarginate.*

* *Basal antennal joint reaching to front.*

EUCINETOPS, Stimpson. Carapace suboblong. Rostrum short, bifid, slightly deflexed. Eyes extremely long and mobile. Outer maxillipedes with the merus joint short, truncated at distal end. Ambulatory legs of moderate length. Type *Eucinetops Lucasii*, Stimpson.

CAMPOSCIA, Latreille. Carapace elongated, subpyriform. Rostrum very short, emarginate. Eyes long and slender. Outer maxillipedes with the merus joint elongated, obovate, and rounded at its distal end. Ambulatory legs very long. Type *Camposcia retusa*, Latreille.

The genus *Eucinetops* in the form of the carapace, eyes, and maxillipedes has some affinity with *Micippa* and its allies; *Camposcia*, in the form of the merus joint of the outer maxillipedes, approaches *Inachus*.

The four following genera (of none of which I have seen specimens) are constituted a distinct subfamily (*Collodinæ*) by Stimpson, on account of the shortness of the rostrum. This character is of scarcely sufficient importance for such a purpose; and it

appears to me that these genera must certainly be arranged in the same subdivision with *Camposcia* and *Eucinetops*.

*COLLODES, *Stimpson*. Carapace subtriangular. Rostrum bifid, with the spines approximated. Merus joint of outer maxillipedes produced internally. Eyes of moderate length. Ambulatory legs all subprehensile, tarsi slender. Type *Collodes granosus*, Stimpson.

*ARACHNOPSIS, *Stimpson*. Carapace narrow, suboblong. Rostrum bifid. Eyes long. Merus joint of the outer maxillipedes broader than long. Ambulatory legs filiform, tarsi straight. Type *Arachnopsis filipes*, Stimpson.

*BATRACHONOTUS, *Stimpson*. Carapace subtriangular. Rostrum emarginate. Merus joint of the outer maxillipedes broad. Ambulatory legs of the first pair extremely long, those of the posterior pairs very short. Type *Batrachonotus fragosus*, Stimpson.

*EUPROGNATHA, *Stimpson*. Carapace subpyriform. Rostrum apparently trifid (the median lobe being the interantennular spine). A præocular spine. Eye large, peduncle short. Merus joint of the outer maxillipedes somewhat L-shaped. Type *Euprognatha rastellifera*, Stimpson.

ACHÆOPSIS, *Stimpson*. Carapace triangular, with the regions well defined. Rostrum short, bifid; postocular spine small; a præocular spine present. Outer maxillipedes with the merus joint elongated. Ambulatory legs slender; three last pairs with the dactyli falciform. Type *Achæopsis spinulosus*, Stimpson.

INACHUS, *Fabr.* Carapace triangular, with the regions well defined. Rostrum very short, bifid; no præocular spine; postocular spine large. Outer maxillipedes with the merus joint elongated. Ambulatory legs elongated, with the terminal joints usually straight. Type *Inachus dorsettensis* (Pennant).

** *Basal antennal joint very short, not reaching to front.*

ONCINOPUS, *De Haan*. Carapace elongate-triangular. Front emarginate. Basal antennal joint very short, the next longer. Merus joint of outer maxillipedes elongated and articulated with the next at its summit. Ambulatory legs slender, the penultimate joints of the first and second pairs more or less dilated and

compressed, the fifth somewhat raised upon the dorsal surface. Type *Oncinopus aranea*, De Haan.

This curious genus in the form of the basal antennal joint comes nearest *Macrocheira*, and also has some affinity with the Grapsoid genus *Elamene* and its allies. In the subdorsally elevated fifth ambulatory legs it approaches the Maioid *Anomura*.

§§ *Rostrum simple.*

**INACHOIDES*, *Milne-Edwards* (*Xiphus*, Eydoux & Souleyet). Carapace triangular, with the regions well defined. No præocular spine. Postocular well developed. Anterior legs with the palm inflated. Ambulatory legs very slender, with the dactyli straight. Type *Inachoides microrhynchus*, M.-Edw. & Lucas.

§§§ *Rostrum long, two-spined.*

* *Spines of rostrum contiguous with one another.*

EURYPODIUS, *Guérin-Ménéville*. Spines of rostrum rather stout, narrowing to distal extremity. Ambulatory legs very long, with the penultimate joint dilated and compressed. Type *Eurypodius Latreillei*, Guérin.

OREGONIA, *Dana*. (Plate XII. figs. 3, 4.) Carapace flattened, not spinose. Spines of rostrum very slender. Ambulatory legs of moderate length, very slender, with the penultimate joint similar to the preceding, not dilated and compressed. Type *Oregonia gracilis*, Dana.

PLEISTACANTHA, *Miers*. Carapace convex, spinose. Spines of rostrum long, divergent at their tips. Anterior legs in male elongated. Ambulatory legs very slender and very long, penultimate joint not dilated and compressed. Type *Pleistacantha sancti-johannis*, Miers.

** *Spines of rostrum divergent.*

1. *Third joint of outer maxillipedes not emarginate at its distal end.*

HALIMUS, *Latreille*. Carapace subtriangular, with lateral marginal spines. Three spines above the eye. Merus joint of the outer maxillipedes somewhat auriculated and produced at its antero-external angle. Anterior legs in male enlarged, palm slightly compressed. Ambulatory legs with the penultimate

joint more or less flattened, and dilated toward its distal end. Type *Halimus auritus*, Latreille.

This genus establishes a transition to the Maiidæ.

AMATHIA, Roux. Carapace subtriangular, spinose. No spines above the eye. Anterior legs of moderate size. Ambulatory legs slender and cylindrical, penultimate joint not dilated. Type *Amathia Rissoana*, Roux.

CHORINUS, Leach. Carapace elongated, convex, without lateral marginal spines. A prominent præocular spine. Eyes very small. Merus joint of the outer maxillipedes not auriculated. Anterior legs in the male greatly elongated. Ambulatory legs of the first pair much elongated, of the last three pairs short. Type *Chorinus heros* (Herbst).

MACROCHEIRA, De Haan. Carapace triangular. Præocular spine small. Basal antennal joint very small, not reaching the front. Merus joint of the outer maxillipedes elongated, and rounded at its distal end (as in *Camposcia* and *Inachus*). Legs very long. Type *Macrocheira Kämpferi*, De Haan.

2. Third joint of the outer maxillipedes notched at its distal end.

ERICHOPLATUS, A. M.-Edwards. Carapace subtriangular. Rostrum bifid, its spines divergent. Basal joint of antennæ rather robust. Anterior legs in male long and slender. Ambulatory legs with the penultimate joint dilated and square-truncated as in *Acanthonyx*. Type *Erichoplatus Huttoni*, A. M.-Edwards.

This genus establishes the transition from the present subfamily to the Acanthonychinæ. The single species was contemporaneously described by me as *Halimus Hectori*, from an imperfect specimen.

Subfamily 3. ACANTHONYCHINÆ. (See Plate XII. figs. 5, 6.) (*Maiens phanérophthalmes*, M.-Edw., part.; *Acanthonychidæ*, Stimpson.)

Eyes small and immobile or partially retractile, and concealed beneath the prominent præocular spine. Basal antennal joint usually enlarged at base and narrowing distally. Postocular spine small or absent.

The carapace is usually more or less oblong and flattened, more rarely elongated and subcylindrical or subtriangular. Rostrum simple or bifid. The merus joint of the outer maxillipedes is truncated at its distal end, and articulated with the next joint at its antero-internal angle. The anterior legs in the male usually have the palm compressed. The ambulatory legs are of moderate length. Postabdomen 4- to 7-jointed.

Some of the genera in the first and second sections of this sub-family approach the Leptopodiinæ in the length of their epistoma, narrow interocular space, and coalescent postabdominal segments. Consequently the Acanthonychinae are to be regarded as a series parallel with, rather than inferior to, the Leptopodiinæ in a natural arrangement.

§ *Carapace elongated, ovate-cylindrical. Rostrum elongated, emarginate or bifurcated. Præocular minute, or wanting. Eyes immobile. Last two pairs of legs very short.*

This section would appear to correspond with Stimpson's sub-family Anomalopinæ.

XENOCARCINUS, *White (Huenioides, A. Milne-Edwards)*. (Plate XII. fig. 5.) Carapace ovate-cylindrical. Præocular spine wanting. Antennæ concealed beneath the rostrum. Type *Xenocarcinus tuberculatus*, White.

*ANOMALOTHIR (*Anomalopus*, Stimpson, nom. præoc.). Carapace almost subcylindrical. Præocular minute. Antennæ visible from above. Type *Anomalothir furcillatus* (Stimpson).

§§ *Carapace in the male subtriangular. Rostrum simple, acute. Ambulatory legs regularly decreasing in length.*

* *Eyes immobile. Sexes (where known) dissimilar.*

*MOCOSOA, *Stimpson*. Carapace subpentagonal. Rostrum subtriangular, entire, obtuse, excavated below. Præocular? Outer maxillipedes with the merus joint short, broad, and produced at its antero-external angle. Anterior legs? Type *Mocosoa crebrepunctata*, Stimpson.

TRIGONOTHIR, *Miers*. Carapace subtriangular. Rostrum entire, obtuse, flattened below, and produced into lateral carinæ. Præocular wanting. Outer maxillipedes with merus joint not produced at its antero-external angle. Anterior legs rather small, palm compressed. Type *Trigonothir obtusirostris*, sp. n.

A single specimen, locality unknown, is in the Museum collection.

ILUENIA, *De Haan*. Rostrum slender, deep, and laterally compressed, acute; præocular spine small. Sexes dissimilar (the carapace in the female being produced into large lateral lobes or expansions). Hands compressed, cristate above. Ambulatory

legs more or less dilated and compressed. Type *Huenia proteus*, De Haan.

SIMOCARCINUS, *Miers*. Rostrum as in *Huenia*, but shorter. Præocular spine wanting. Sexes dissimilar. Hands in adult male turgid, not cristate above. Ambulatory legs not compressed. Type *Simocarcinus simplex* (Dana).

The type of this genus is the *Huenia simplex* of Dana: this species and his *H. brevirostrata* are obviously male and female of the same form. Specimens are in the British Museum of both sexes.

CYCLONYX, *Miers*. Rostrum laminate, flattened, very broad, and transversely oval in shape. Eyes situated in the narrow angle between the base of the rostrum and front of the carapace, the sides of which are produced into dilated wing-like expansions as in *Huenia*. Type *Cyclonyx frontalis* (White). Only known from a single female in bad condition.

** *Eyes mobile. Sexes similar.*

MENÆTHIUS, *M.-Edw.* Rostrum slender, acute. Præocular spine well developed. Carapace subtriangular. Anterior legs with the palm slightly compressed, fingers arcuate. Ambulatory legs not compressed. Type *Menæthius monoceros*, Latr.

§§§ *Carapace usually more or less oblong or orbiculate in outline. Rostrum flattened, emarginate, bifid, or two-spined. Præocular usually well developed. Eyes mobile. Basal antennal joint dilated at base, narrowing distally. Ambulatory legs of moderate length.*

* *Flagellum of antennæ concealed beneath the rostrum and not visible from above.*

**LEUCIPPE*, *M.-Edwards*. Rostrum laminate, divided by a narrow median fissure. Carapace subtriangular or subpentagonal. Præocular spine wanting. Basal antennal joint not much enlarged at the base. Type *Leucippe pentagona*, M.-Edwards.

This genus marks the transition from the preceding section to the present one.

MIMULUS, *Stimpson*. Rostrum laminate, bifid. Carapace flattened, subpentagonal, with the lateral margins in both sexes produced into bilobate laminate expansions. Præocular

spine present. Basal antennal joint not much enlarged at base. Type *Mimulus foliatus*, Stimpson.

EPIALTUS, *M.-Edwards*. Rostrum lamellate, emarginate. Præocular spine present. Basal antennal joint considerably enlarged at base. Ambulatory legs with the penultimate joint not dilated and compressed.

Subgenus 1. EPIALTUS. Carapace suboblong. Second tooth of the antero-lateral margins greatly developed. Type *Epialtus bituberculatus*, *M.-Edwards*.

Subgenus 2. ANTILIBINIA, *M'Leay*. Carapace suboval, smooth, or uneven. Second tooth of the antero-lateral margins small. Type *Antilibinia Smithii*, *M'Leay*.

I place in this subgenus the W.-American species with smooth oval carapace. *M'Leay*'s type species is from S. Africa. In the American species (*E. dentatus*, *E. emarginatus*) the orbital margin, although not prominent, is so well defined and circular that they might almost be separated as a distinct genus, and placed near *Scyra* in the Periceridæ. *A. Smithii* externally resembles the species of *Libinia*.

*EUPLEURODON, *Stimpson*. Carapace depressed and uneven; antero-lateral angles strongly prominent. Ambulatory legs strongly prehensile, penultimate joints dentigerous. Type *Eupleurodon trifurcatus*, *Stimpson*.

This genus seems to be in some degree intermediate between the subgenera *Epialtus* and *Antilibinia*.

** *Flagellæ of antennæ exposed and visible from above at side of rostrum (basal joint of antennæ not much enlarged at base).*

PUGETTIA, *Dana (Peltinia, Dana)*. Carapace somewhat constricted behind the second lateral spine. Ambulatory legs slender, with the penultimate joint not dilated or compressed. Type *Pugettia gracilis*, *Dana*.

ACANTHONYX, *Latreille*. (Plate XII. fig. 6.) Carapace usually suboblong, not constricted behind the second lateral spine. Ambulatory legs with the penultimate joint more or less flattened, dilated, and compressed. Type *Acanthonyx lunulatus*, *Risso*.

(The genus *Dehaanius* of *M'Leay*, *Annulosa* in *Smith's S. Africa*,

p. 57, pl. iii. fig. *a*, would seem, from the figure and the position assigned to it by its author, to have the eyes retractile within well-defined orbits, and hence to be referable to the family Maiidæ. Except as regards the orbital characters, the species figured (*Dehaanius acanthopus*) altogether resembles the S.-African *Acanthonyx dentatus*, M.-Edw. Perhaps there is some error in M'Leay's delineation of the species in question.)

Subfamily 4. MICRORHYNCHINÆ.

Eyes short and completely retractile; the postocular spine or lobe largely developed. Basal antennal joint considerably enlarged throughout its length (except in some *Docleæ*). Præocular spine short or absent.

The rostrum is simple or more or less bifurcated. Carapace more or less triangular and convex. The merus joint of the outer maxillipedes cordiform, or truncated at its distal extremity. Legs usually rather slender. Postabdomen of male and female 6- to 7-jointed.

This group is altogether intermediate in the structure of the orbital and antennal region between the Inachidæ and the Maiidæ. The genus *Loxorhynchus*, for example, closely approaches in these respects *Pisa* and its allies; but the upper orbital margin is not developed as in the genera of that section of Maiidæ. Of most of the genera I have seen no specimens.

§ *Rostrum simple. No præocular spine.*

*MICRORHYNCHUS, *Bell* (? *Salacia*, M.-Edwards & Lucas). Carapace broadly triangular. Rostrum very short. Merus joint of outer maxillipedes somewhat cordiform. Anterior legs in male small. Ambulatory legs of moderate length. Type *Microrhynchus gibbosus*, *Bell*.

*APIOMAIA, *v. Martens* (*Pyromaia*, *Stimpson*). Carapace somewhat pyriform. Merus joint of outer maxillipedes with the antero-internal lobe strongly projecting. The rest nearly as in *Microrhynchus*. Type *Apiomaia cuspidata* (*Stimpson*).

*ESOPUS, *A. Milne-Edwards*. Carapace elongate-oval, convex. Front rounded at its distal end. Outer maxillipedes with the merus joint slightly produced at its antero-lateral angle. Type *Esopus crassus*, *A. M.-Edwards*.

§§ *Rostrum bifid or emarginate. A præocular spine usually present.*

LOXORHYNCHUS, *Stimpson*. Rostrum slightly deflexed, bifid;

the spines coalescent at base, and then divergent. A prominent præocular and postocular spine. Basal joint of antennæ considerably enlarged. Merus joint of outer maxillipedes entire at its distal end. Ambulatory legs of moderate length. Type *Loxorhynchus grandis*, Stimpson.

**LIBIDOCLEA*, *M.-Edwards*. Rostrum prominent, not deflexed and emarginate at its distal end. Merus joint of outer maxillipedes notched at its distal margin. Legs rather long. Type *Libidoclea granaria*, M.-Edw. & Lucas.

This genus is closely allied to *Libinia* in the family Periceridæ.

DOCLEA, *Leach*. Carapace orbiculate-triangular, or orbiculate. Rostrum usually very short, emarginate. No præocular spine. Basal antennal joint but moderately enlarged at base. Legs very long and slender. Type *Doclea Rissonii*, Leach.

This genus is closely allied to *Egeria*, and marks the transition to that genus of Maiidæ.

Subfamily 5. STENOCIONOPINÆ.

Eyes elongated and retractile, partly concealed by the præocular spine, which is very greatly elongated. Basal antennal joint considerably enlarged throughout its length.

The rostrum is composed of two spines. Carapace somewhat oblong and posteriorly prolonged. The articulation of the merus joint of the outer maxillipedes with the preceding joint is often very peculiar.

The enlarged basal antennal joint marks the approach of this subfamily to the Maiidæ. Were the upper orbital margin as well developed in all the genera as in *Tyche*, it would be better to constitute it a subfamily of that group.

**STENOCIONOPS*, *Latreille*. Upper orbital margin behind præocular spine not developed. Posterior lobe of the carapace simple. Merus joint of outer maxillipedes greatly produced and acute at its antero-external angle, and with a notch on its inner margin for the insertion of the fourth joint. Type *Stenocionops cervicornis* (Herbst).

**STILBOGNATHUS*, *v. Martens*. Facies of *Stenocionops*. Ischium joint of the outer maxillipedes with a longitudinal pit on its outer surface which is covered with bristles; merus joint convex and

shining, with a flat rounded lobe at its antero-external angle. Type *Stilbognathus erythræus*, v. Martens.

TYCHE, *Bell* (*Platyrrhynchus*, Desb. & Schramm*). Upper orbital margin behind the præocular spine well developed, laterally produced, and concealing the eyes, with a deep fissure. Ischium and merus joints of outer maxillipedes flat and smooth, the third or merus joint dovetailed into the second, not produced, or with a small lobe at its antero-external angle. Type *Tyche lamellifrons*, *Bell*.

Family II. MAIIDÆ.

Eyes retractile within the orbits, which are distinctly defined; but often more or less incomplete below, or marked with open fissures in their upper and lower margins. Basal antennal joint always more or less enlarged.

Subfamily 1. MAINÆ. (See Plate XII. figs. 7-10.)

(*Maïens cryptophthalmes*, M.-Edwards, part.).

Carapace usually subtriangular. Rostrum well developed. Anterior legs in male enlarged; fingers not excavate at tips.

This subfamily includes most of those typical forms which group themselves around the common *Maia*, in which the carapace is usually triangular or elongate-triangular, the rostrum emarginate or two-spined, the orbits large, well defined and yet incomplete, eyes completely retractile, anterior legs with fingers acute, and ambulatory legs usually of moderate length.

Stimpson proposed to separate as a distinct subfamily (*Leptopinæ*) the group typified by *Egeria* (*Leptopus*, Latr.), on account of the broad and somewhat cordiform merus joint of the outer maxillipedes. *Egeria* could not in any case be taken as typical of the group, as in it the merus joint of the outer maxillipedes is not cordiform, but truncated at its distal end. A certain affinity undoubtedly exists between the genera in which the merus joint is cordiform, as also between those (typified by *Camposcia*) which have the merus joint elongated, often rounded at the distal end, and articulated with the next at the summit; but these characters cannot be employed as a basis for a general classification, and do

* I have not had an opportunity of consulting Dr. Schramm's work, 'Crustacés de la Guadeloupe d'après un manuscrit du docteur Desbonne, 1re partie, *Brachyura*. Basse-Terre, 8vo, 1867.' In referring to it I have followed M. A. Milne-Edwards's citations.

not always harmonize with the characters derived from the structure of the orbits and antennæ.

§ *Rostrum vertically compressed and laminated, bifid, or notched at the extremity. Orbits shallow and very open above, so that the eyes, when retracted, are more or less visible from above, the eyes themselves short and thick.*

* *Ambulatory legs extremely long and slender.*

EGERIA, *Latr.* (*Leptopus*, Lamk., pt.). Carapace broadly triangular, spinose. Rostrum prominent, notched. Orbits with two wide fissures below. Basal antennal joint rather narrow. Anterior legs of male rather small. Type *Egeria longipes* (Herbst).

CHORILIBINIA, *Lockington*. Carapace triangular. Rostrum long, the spines coalescent at base and divergent at tip. Basal antennal joint moderately enlarged. Upper orbital margin very prominent. Eye-peduncles short. Type *Chorilibinia angusta*, Lockington.

** *Ambulatory legs of moderate length.*

a. *Carapace not spinose.*

*HEMUS, *A. Milne-Edwards*. Rostrum deflexed, notched at the extremity. Basal joint of antennæ enlarged; the second and third joints also dilated and visible from above, with lateral wing-like expansions. Merus joints of the ambulatory legs considerably dilated. Type *Hemus cristulipes*, A. Milne-Edwards.

HYAS, *Leach*. Rostrum bifid; the median fissure narrow. Basal joint of antennæ not much enlarged, the second joint moderately dilated, the third joint narrow. Ambulatory legs not dilated or compressed. Type *Hyas araneus* (Linn.).

CHIONÆCETES, *Kröyer* (*Peloplastus*, Gerstäcker). Rostrum notched, not deflexed. Basal joint of antennæ very narrow, second and third not dilated. Ambulatory legs in the adult with the joints somewhat compressed and flattened. Type *Chionæcetes opilio*, Kröyer.

b. *Carapace spinose.*

HERBSTIA, *Milne-Edwards* (*Rhodia*, Bell, *Micropisa*, Stimpson). Rostrum notched. Carapace broadly triangular, with the regions

well defined. Second and third joints of antennæ slender. Ambulatory legs slender, cylindrical.

Subgenus 1. *HERBSTIA*. Inferior margin of orbit without a tooth. Ambulatory legs not spinose. Type *Herbstia condyliata* (Herbst).

Subgenus 2. **HERBSTIELLA*, *Stm.* Inferior margin of orbit toothed. Merus joint of ambulatory legs spinose. Type *Herbstiella depressa*, *Stm.*

This genus establishes a relationship to *Mithrax*.

**CÆLOCERUS*, *A. Milne-Edwards*. Carapace suborbiculate. Rostrum prominent, with a shallow notch at its distal end, and its lateral margins involuted. Second and third joints of antennæ slender. Legs short. Type *Cælocerus spinosus*, *A. M.-Edwards*.

Is nearly allied to *Libinia*; and it may be desirable so to modify its characters as to include any species of that genus which may have the orbital margin incomplete or notched. The involution of the margins of the rostrum is of minor importance, as the same character occurs in a lesser degree in the typical species of *Libinia* (*L. emarginata*).

§§ Rostrum composed of two more or less distinct divergent spine
Orbits deep, so that the eyes, when retracted, are concealed; the eyes themselves small, the eye-peduncles slender.

† Orbits large, with a forward aspect, usually very incomplete below, the upper orbital margin usually prominent, with two deep fissures and long spines.

*Flagellum of the antennæ arising within the orbital cavity.

MAIA, *Lamarck*. (Plate XII. figs. 7, 8.) Spines of rostrum divergent from their base. Carapace triangulate-oblong, the interorbital space broad. Basal joint of antennæ very much enlarged. Anterior legs in male rather slender; wrist elongated, not carinated. Type *Maia squinado* (Linn.).

**Flagellum of the antennæ arising within the orbital margin, and separated from the cavity of the orbit by a narrow process of the basal joint.

PARAMITHRAX, *M.-Edwards*. Carapace subtriangular. Spines of rostrum divergent from their base. Anterior margin of buccal cavity straight, or nearly so. Basal joint of antennæ very much

enlarged. Merus joint of outer maxillipedes notched at its antero-internal angle.

Subgenus 1. *LEPTOMITHRAX*, *Miers*. Anterior legs in male elongated, slender; hand and wrist subcylindrical; wrist not ridged, fingers meeting along their inner edges when closed. (Carapace not spinose above.) Type *Leptomithrax longimanus*, *Miers*.

Subgenus 2. *PARAMITHRAX*, *M.-Edw*. Anterior legs in the male enlarged; hand compressed, fingers with a vacant space between them when closed, wrist with two ridges, the outer usually oblique. (Carapace usually spinose above.) Type *Paramithrax Peronii*, *M.-Edw*.

As regards external form, every gradation appears to be established between the typical *Paramithrax* and *Acanthophrys*, in which the carapace and legs are more or less spinose, the upper orbital margin produced above; but the spine at the antero-external angle of the basal joint of the antennæ projects laterally instead of forward, as in that genus; and the form of the merus joint of the outer maxillipedes is different.

(The genus **Phycodes*, established by A. Milne-Edwards on a species, *P. antennarius*, from St. Vincent, has, I believe, never been figured, but should perhaps be referred to the vicinity of *Paramithrax*. The carapace is pyriform. Spines of rostrum short, acute. Orbits large, ill-defined, emarginate above; eyes partially retractile; postocular spine large. Basal antennal joint long, enlarging distally, ending in two spines, of which the outer is very prominent; flagellum inserted outside rostrum. Third joint of outer maxillipedes much larger on its outer than its inner side. Ambulatory legs long; dactyli curved. There appears to be some inconsistency in the generic and specific descriptions of the frontal and orbital region.)

**OPLIPISA*, *A. Milne-Edwards*. Carapace pyriform. Spines of rostrum straight, divergent. Anterior margin of buccal cavity much more prominent on the sides than in the median portion. Merus joint of outer maxillipedes much dilated at its antero-external angle. Ambulatory legs short, and regularly spinose. Type *Oplopisa spinipes*, *A. Milne-Edwards*.

ACANTHOPHRYS, *A. Milne-Edwards*. Carapace subtriangular. Spines of rostrum divergent. Upper orbital margin prominent. Supraocular spine produced above the eye. Basal antennal joint

with a spine at its antero-external angle, which projects forward. Anterior margin of buccal cavity straight, or nearly so. Merus joint of outer maxillipedes dilated at its distal margin, rounded and entire, without any notch for the insertion of the next joint. Type *Acanthophrys cristimanus*, A. Milne-Edwards.

I propose to restrict this genus to species characterized by the entire merus joint of the outer maxillipedes, as there appears to be no other certain distinction between it and *Paramithrax*, and accordingly cite *A. cristimanus* as the type, because (if the figure be correct) it presents this peculiarity. Two species of the genus are in the British-Museum collection.

†† *Orbits small, with a lateral aspect; orbital margin not prominent, with a hiatus above and below (rarely in Pisa there are two hiatus above).*

PISA, *Leach*. (Plate XII. figs. 9, 10.) Carapace triangular, rounded behind. Præocular spine usually large. Spines of rostrum long, parallel, or in contact, to near their extremities. Epistome transverse, rather narrow. Basal joint of antennæ much enlarged, and terminating at its distal extremity in one or two spines or tubercles.

Subgenus 1. PISA, *Leach* (*Blastus*, *Leach*). Anterior legs in the male with the palm dilated; fingers curved, and meeting only at the ends. Carapace ovate-triangular. Type *Pisa tetraodon* (Pennant).

Subgenus 2. ARCTOPSIS, *Lamarck*. Carapace subtriangular. Anterior legs in the male with the palms elongated and rather slender; fingers straight, and meeting along their inner edges. Type *Arctopsis lanata*, *Lamarck*.

*PISOIDES, *Milne-Edwards & Lucas*. Carapace subtriangular. Spines of rostrum short, subparallel. No præocular spine. Epistome very narrow, nearly linear. Basal antennal joint with a tubercle at its distal end. Type *Pisoides Edwardsii* (Bell).

NOTOLOPAS, *Stimpson*. Carapace with the back flattened, and bounded posteriorly by a broad concave lamella. Rostrum with the spines divaricate. A præocular spine. Basal joint of antennæ with a lobe at its distal end. Type *Notolopas lamellatus*, *Stimpson*.

HYASTENUS, *White (Lahaina, Dana)*. Carapace triangular, rounded behind. Spines of rostrum long, straight, divergent from their base. Præocular spine small or obsolete. Orbits small, with a hiatus above and one below. Basal joint of antennæ not much enlarged. First ambulatory legs greatly elongated.

Subgenus 1. **HYASTENUS**. Carapace smooth and even above, with none or with few long spines. Basal joint of antennæ without a spine at its distal end. Anterior legs in male small and slender. Type *Hyastenus Sebæ*, White.

Subgenus 2. **CHORILIA**, *Dana*. Carapace uneven and tubercular above. Basal joint of antennæ usually with a spine at its distal end. Anterior legs in male usually enlarged, with the palm compressed. Type *Chorilia longipes*, Dana.

(The genus *Lahaina*, Dana, is intermediate between *Hyastenus* and *Chorilia*. In the form of the carapace and rostrum and anterior legs it resembles the first; in the presence of a præocular spine, and the existence of a spine on the basal joint of the antennæ, the second. Nevertheless, as the subgenera *Hyastenus* and *Chorilia* represent two types of the genus differing much in external appearance, it seems better to retain them as distinct.)

NAXIA, *M.-Edw. (Naxioides, A. Milne-Edwards; Podopisa, Hilgendorf)*. Carapace subtriangular. Spines of rostrum parallel, and bearing near their extremities an accessory spinule. Præocular spine usually present. Orbits as in *Hyastenus**. Basal joint of antennæ longer than broad; its antero-external angle tuberculiform. First ambulatory legs very long. Type *Naxia serpulifera*, M.-Edwards.

Scarcely distinct, perhaps, as a genus, from *Hyastenus*.

MICIPPOIDES, *A. Milne-Edwards*. Carapace subtriangular. Spines of rostrum rather short, deflexed, acute. No præocular spine. Basal joint of antennæ enlarged, without spine or tubercle at its distal end. Anterior legs in male with the palm dilated. Ambulatory legs of moderate length. Type *Micippoides angustifrons*, A. M.-Edwards.

Marks a transition to *Prionorhynchus* among the Periceridæ.

* In young specimens of *N. serpulifera* the fissures of the orbits are wider, and constitute a veritable hiatus. It appears, therefore, necessary to unite *Naxioides*, A. M.-Edwards, with this genus, as it is only distinguished by the absence of a præocular spine, a character which by itself cannot be considered of generic importance.

EURYNOME, *Leach*. Carapace subtriangular, tuberculated, and spinose. Spines of rostrum laminate at base, acute at ends, slightly divergent. No præocular spine. Basal antennal joint enlarged at base, longitudinally sulcated, without a spine at its distal end. Anterior legs in male elongated, much longer than the ambulatory legs, which are all of moderate length. Type *Eurynome aspera* (Pennant).

This genus has been placed by Milne-Edwards and other authors in the Parthenopidæ; but in all structural characters it is obviously allied to *Pisa* and *Hyastenus*.

PELIA, *Bell*. Carapace subpyriform. Rostrum with the spines united at base, afterwards divergent. No præocular spine. Basal antennal joint elongated; its distal half visible from above at the side of the rostrum. Legs all of moderate length. Type *Pelia pulchella*, *Bell*.

Subfamily 2. SCHIZOPHRYSINÆ.

Carapace very broadly triangular, or oval, or nearly circular. Rostrum very short or obsolete. Anterior legs in male small, slender; the fingers usually excavated at the tips.

This subfamily establishes the transition of the Maiidæ to the subfamily Mithracinæ in the Periceridæ, and includes those Maioids in which the rostrum is reduced, until in *Cyclax* its spines are represented only by two small tubercles, the orbits often nearly complete, or marked with very narrow fissures, the carapace broadly triangular or nearly circular, the epistome short, the basal antennal joint very largely developed, and the anterior legs with the fingers more or less excavated.

§ *Anterior legs with the fingers acute at the tips.*

**TEMNONOTUS*, *A. Milne-Edwards*. Carapace ovate-elliptical, convex and tuberculated above, with a horseshoe-shaped pit on the dorsal surface. A præocular spine present. Spines of rostrum simple, well developed. Orbital fissures narrow; eyes short, thick. Basal joint of antennæ much enlarged. Type *Temnonotus granulósus*, *A. M.-Edwards*.

Only females of this genus are known; and it is possible that in adult males the fingers may be excavated as in other genera of the same group.

§§ *Anterior legs with the fingers excavated at the tips.*

SCHIZOPHRYS, *White* (*Dione*, De Haan, nom. præoc.). Carapace orbiculate-triangular or rarely elongated. Spines of rostrum distinct, with one or more accessory spines upon their outer margins. Orbits large. Basal joint of antennæ rather slender, with two spines at its distal end. Type *Schizophrys aspera* (Milne-Edwards).

The fingers are acute and not excavated in *S. dama* (Herbst), a species which differs from others of the genus in its more elongated form, and approaches the *Maidæ*.

CYCLAX, *Dana*. Carapace orbiculate or oblong-orbiculate. Spines of rostrum simple, very short or rudimentary. Orbits large. Basal joint of antennæ usually much enlarged.

The accessory spines of the rostrum of *Schizophrys* constitute the only positive distinction (although an arbitrary one) that can be employed to separate the species of that genus from *Cyclax* and *Nemausa*.

Subgenus 1. CYCLAX, *Dana*. Spines of rostrum longer. Eye-peduncles longer. Basal joint of antennæ slenderer, with two spines at its distal end. Type *Cyclax Perryi*, *Dana*.

Subgenus 2. CYCLOMAIA, *Stimpson*. Spines of rostrum rudimentary. Eyes large. Basal joint of antennæ very broad, with three spines at its distal end. Type *Cyclomaia suborbicularis*, *Stimpson*.

(The genus **Pleurophricus* of Alphonse Milne-Edwards, founded upon a species, *P. cristatipes*, from Australia (Journ. Mus. Godeffroy, iv. p. 84, pl. xii. fig. 6, 1873), is placed by that distinguished carcinologist among the Oxyostomata; but judging from the description and figure of the third maxillipede, I should certainly suppose its true position to be in this subfamily of the Oxyrhyncha. It is distinguished from *Cyclax*, *Schizophrys*, and *Temnonotus* by the anterior legs, which are short and somewhat enlarged, and by the front, which is quadridentate.)

Subfamily 3. MICIPPINÆ. (See Plate XIII. figs. 1, 2, 3.)

Carapace suboblong. Rostrum vertically, or nearly vertically, deflexed, usually broad, lamellate. Anterior legs with the fingers acute at tips. Basal antennal joint very much enlarged. Eye-peduncles very long, geniculated, and laterally projecting.

Notwithstanding the great dissimilarity of *Micippa* and *Picrocerus*, which stand at opposite extremes of the series, a regular gradation may be traced between the genera of this group. In *Picrocerus* the broad and lamellate rostrum of *Micippa* and *Paramicippa* is reduced to a single vertically deflexed spine, the præocular spines are enormously developed, and constitute the apparent rostrum; the anterior part only of the upper wall of the orbit is developed, the posterior part, which is complete in *Micippa*, being represented only by two or three spines: hence the carapace behind the eyes appears constricted; the basal antennal joint, moreover, is narrower and elongated. *Criocarcinus* occupies an intermediate position between *Micippa* and *Picrocerus*.

§ *Orbits very incomplète, the anterior portion partially surrounding the eye-peduncle, and usually of the form of a tube open below, the posterior portion often represented only by one or two spines.*

CRIOCARCINUS, *M.-Edwards*. (Plate XIII. fig. 3.) Orbits tubular, open below; præocular spines small. Rostrum lamellate at base, and terminating in two divergent spines. Legs of moderate length. Type *Criocarcinus superciliosus* (Herbst).

PICROCERUS, *Alphonse Milne-Edwards*. Orbits tubular, open below. Rostrum rudimentary, composed of a single vertically deflexed spine. Præocular spines enormously developed, horizontal, and slightly divergent; constituting the apparent rostrum. Legs long and slender. Type *Picrocerus armatus*, A. M.-Edwards.

PSEUDOMICIPPE, *Heller*. Orbits not tubular, covering the eye-peduncles above, not defined below, with a hiatus above. Rostrum obliquely deflexed, composed of two divergent spines. Præocular spines small. Legs of moderate length. Type *Pseudomicippe nodosa*, Heller.

Establishing the transition to *Tyche* and its allies.

§§ *Orbits of a narrow oval form, well defined; basal antennal joint much enlarged.*

MICIPPA, *Leach*. (Plate XIII. figs. 1, 2.) Rostrum nearly vertically deflexed. Anterior legs in male with the palm elongated and rather slender; fingers meeting along their inner edges when closed. Type *Micippa cristata* (Linn.).

PARAMICIPPA, *M.-Edwards*. Rostrum less vertically deflexed. Anterior legs in the male with the palm enlarged, shorter, smooth; fingers, when closed, meeting only at the ends. Type *Paramiccippa platipes* (Rüppell).

The eyes are, I believe, retractile in both genera; and the characters derived from the orbital and antennal region are subject to variation.

Family III. PERICERIDÆ. (*Maiens cryptophthalmes*, *M.-Edwards*, part.)

Eyes retractile within the small circular and well-defined orbits, which are never incomplete as in the Maiidæ. Basal antennal joint well developed, and constituting the greater portion of the inferior wall of the orbit; this joint is usually very considerably enlarged.

Subfamily 1. PERICERINÆ. (See Plate XIII. figs. 4, 5.) (*Pericerinæ*, Stimpson.)

Carapace more or less subtriangular in shape. Rostrum well developed. Second joint of antennæ not dilated. Anterior legs with the fingers acute at the tips.

In this subfamily are included those which may be regarded as the typical genera of this family, in which the spines of the rostrum are well developed, and often in contact with one another. The interorbital space is very broad, and the orbits tubular; the basal joint of the antennæ very much enlarged, the epistoma short, the legs of moderate length, and the fingers acute at tips. One or two of the genera (*Scyra*, *Sphenocarcinus*), in which the basal antennal joint is least developed, are related to the Epialtinæ.

§ *Rostrum emarginate at apex only.*

LIBINIA, *Leach*. Carapace orbiculate-triangular, convex, spinose. Præocular spine distinct. Basal joint of antennæ moderately enlarged. Legs of moderate length. Type *Libinia emarginata*, *Leach*.

PRIONORHYNCHUS, *Jacquinet & Lucas*. Carapace subtriangular. Præocular spine absent. Rostrum broad, lamellate, deflexed and emarginate at its distal end. Basal joint of antennæ greatly enlarged. Type *Prionorhynchus Edwardsii*, *Jacq. & Lucas*.

§§ *Rostrum composed of two distinct spines.*

* *Basal joint of antennæ without a spine at its distal extremity.*

SCYRA, *Dana*. Præocular spine present. Spines of rostrum lamellate at base, acute at distal end. Basal joint of antennæ narrow. Anterior legs rather long, palm carinated. Ambulatory legs not compressed. Type *Scyra acutifrons*, *Dana*.

*PYRIA, *Dana*. Præocular spine absent. Spines of rostrum lamellate. Anterior legs slender. Ambulatory legs much compressed. Type *Pyria pubescens*, *Dana*.

Nothing is said respecting the orbits and basal antennal joint; if the orbits are incomplete, this genus would probably be placed near *Chionæcetes*.

LISSA, *Leach*. Carapace very convex. Præocular spine present. Spines of rostrum flattened, contiguous, and produced at their extremities into a lateral lobe. Basal joint of antennæ much enlarged. Anterior legs with the palm compressed but not carinated. Ambulatory legs of moderate length. Type *Lissa chiragra* (*Fabr.*).

*RACHINIA, *A. Milne-Edwards*. Præocular spine present. Spines of rostrum slender and divergent. Anterior legs with the palm compressed but not carinated. Ambulatory legs very slender. Type *Rachinia gracilipes*, *A. Milne-Edwards*.

The description of this genus is taken from the figure in the 'Mission Scient. Mexique, Crustacés Podophthalmaires,' pl. xviii. fig. 1. The species is noticed, but not described, in a footnote on p. 86. Of this fine work, which contains descriptions and figures of many new genera and species, only a portion, referring to the Crustacea Xiphosura and a part of the Oxyrhyncha, has yet appeared (5me partie, livraisons 1-3. Paris, 4to, 1873 & 1875).

*LEPTOPISA, *Stimpson*. Carapace narrow, with perpendicular sides. Spines of rostrum very slender and contiguous. Anterior legs in the male large; fingers widely gaping. Ambulatory legs long and slender. Type *Leptopisa setirostris*, *Stimpson*.

*SPHENOCARCINUS, *A. M.-Edwards*. Carapace triangular. Rostrum elongated, its spines contiguous to within a very short distance of their extremities, which are acute. Anterior legs small. Ambulatory legs of moderate length. Type *Sphenocarcinus corrosus*, *A. M.-Edwards*.

This genus is only known to me from M. A. Milne-Edwards's figure in the 'Mission Scientif. Mexique' (pl. xvii. fig. 5), from which the diagnosis is taken. Its nearest ally among the Pericerinæ seems to be *Seyra*, Dana. If the orbits are incomplete, it would probably be placed among the Epialtinæ. It agrees, however, with most of the Periceridæ in having a short epistome.

**** Basal joint of antennæ often very much enlarged, with one or more spines at its distal extremity.**

† Carapace narrow and elongated, nearly vertically deflexed in front of gastric region.

CYPHOCARCINUS, *A. M.-Edwards*. Spines of rostrum slender and divergent. Spine of basal antennal joint small. Type *Cyphocarcinus minutus*, *A. M.-Edwards*.

†† Carapace subtriangular, not deflexed in front.

1. Spine at antero-external angle of antennal joint very short, and not visible from above.

TIARINIA, *Dana*. Carapace tuberculated, without a distinct series of lateral spines. Spines of rostrum very slender and contiguous. Interorbital space broad. Anterior legs in male with the palm short; fingers gaping. Ambulatory legs nodose or spinose. Type *Tiarinia cornigera* (Latreille).

TYLOCARCINUS, *Miers* (τύλος, a knob). Carapace tuberculated, without lateral spines. Spines of rostrum slender, divergent. Interorbital space narrow. Basal antennal joint not much enlarged. Anterior legs in male with the fingers nearly meeting when closed. Ambulatory legs spinose or nodose. Type *Tylocarcinus styx* (Herbst).

PERICERA, *Latreille*. (Plate XIII. figs. 4, 5.) Carapace with a series of lateral spines. Spines of rostrum long and divergent. Interorbital space broad. Basal joint of antennæ very much enlarged, with two small distant spines at its distal end. Anterior legs long, palm slender and elongated, fingers not gaping. Ambulatory legs smooth. Type *Pericera cornuta*, Latreille.

2. Spine at antero-external angle of basal antennal joint very long, and visible from above.

MICROPHRYS, *Milne-Edwards* (*Milnia*, Stimpson; *Perinea*,

Dana; *Fisheria*, Lockington). Carapace broadly triangular. Spines of rostrum slender and more or less divergent. Branchial spine small. Orbits not tubular. Anterior legs in male enlarged; fingers arcuate, and meeting only at the tips. Antennæ visible from above at sides of rostrum. Type *Microphrys bicornuta* (Latreille).

(The genus *Omalacantha* of Hale Streets, of which I have seen no specimen, is very closely allied to this genus, and ought perhaps to be united with it, as M. A. Milne-Edwards has pointed out. It is, however, stated by its author to be sufficiently distinguished by the flattened club-shaped joints of the antennæ; and I prefer, for the present, to regard it as distinct. In the genus *Perinea*, Dana, which establishes the transition from *Microphrys* to the next genus, the carapace is convex and the rostrum very short.)

MACROCÆLOMA, *Miers*. Carapace very convex. Branchial spine very large. Spines of rostrum parallel, or nearly so. Orbits tubular and laterally projecting; interorbital space very broad. Anterior legs in male with the palm elongated, and fingers meeting, or nearly meeting, when closed. Type *Macroceloma trispinosa* (Latreille).

This genus is proposed for that section of the old genus *Pericera* in which is included *P. trispinosa* and its allies.

*ANAPTYCHUS, *Stimpson* (*Ala*, Lockington). Carapace broadly triangulate, with the lateral margins laminated, produced over the bases of the ambulatory legs, and regularly dentated. Spines of rostrum short. Anterior legs in male rather slender; fingers nearly meeting throughout when closed. Type *Anaptychus cornutus*, Stimpson.

Subfamily 2. OTHONIINÆ. (See Plate XIII. fig. 6.) (*Othoninæ*, Dana, Stimpson.)

Carapace suboblong; interorbital space very broad. Rostrum almost obsolete. Second joint of antennæ enlarged. Anterior legs with the fingers slightly excavated at the tips.

This subfamily is restricted to the single genus

OTHONIA, *Bell* (*Pitho*, Bell). (Plate XIII. fig. 6.) Carapace with the margins regularly dentated. Type *Othonia sexdentata*, Bell.

Subfamily 3. MITHRACINÆ. (See Plate XIII. figs. 7, 8.)
(*Mithracinæ*, Stimpson.)

Carapace broadly triangular, sometimes transverse, with the sides slightly arcuate; interorbital space narrow. Rostrum short or obsolete. Second joint of antennæ not dilated. Anterior legs with the fingers excavated at the tips.

In this subfamily are included those Periceridæ which most nearly approach the Cancroids of the subfamily Chlorodiinæ in the form of the carapace, the obsolescence of the rostral spines, the small and completely defined orbits (which do not project laterally as in the Pericerinæ), the extremely short epistoma, and the form and development of the anterior and ambulatory legs. *Mithraculus*, which stands at the end of the series, is indeed hardly to be distinguished in external form from the Cancroid *Phymodius* or *Chlorodius*, from which, however, it is in reality separated by the position and great development of the basal antennal joint. *Nemausa*, on the other hand, marks the transition to the Maiidæ.

NEMAUSA, *Alphonse Milne-Edwards*. Carapace longer than broad; spines of rostrum well developed. Basal joint of antennæ with a long spine at its distal end. Anterior legs in male not much enlarged; palm slender. Ambulatory legs not compressed. Type *Nemausa spinipes* (Bell).

This genus presents affinities with *Microphrys*, and also with *Herbstia* and *Schizophrys* among the Maiidæ.

PARATHOË, *Miers*. Carapace triangular, rounded behind. Front very small and narrow, truncated or notched. Basal antennal joint narrow as in *Scyra*, longer than broad, and without any spine at its distal end. Anterior legs with the palm dilated, and fingers arcuate, meeting at the tips. Ambulatory legs not dilated, and compressed. Type *Parathoë rotundata*, Miers.

Its habitats (the Gulf of Suez and Fiji Islands) are of great interest, as the subfamily is almost exclusively American. The examples before me have nearly the aspect of *Thoë*; hence the generic name.

(The genus *Paramaya* of De Haan was founded upon a species which he subsequently referred (rightly I believe) to *Maia*. The name may, however, have to be retained for the *Paramaya Dehaani* of White, referred to in his 'List of Crustacea in the British Museum,' p. 7 (1847). This species is founded upon a single female specimen, bleached and probably immature, which closely resembles *Mithrax*, but differs from the species of that genus in

there being no tubercles or spines on the lateral margins of the carapace and very obscurely marked tubercles on the branchial regions. The orbital margins, also, are smooth. The much dilated basal antennal joint has a single spine at its extero-distal angle; the legs are smooth.)

THOË, *Bell* (*Platypes*, Lockington). Carapace triangular, narrowed anteriorly. Rostrum very short, its spines reduced to tubercles. Basal antennal joint with a very short spine at its distal end. Anterior legs in male enlarged, palms short, dilated, fingers meeting only at tips. Ambulatory legs compressed and dilated. Type *Thoë erosa*, Bell.

MITHRAX, *Leach*. (Plate XIII. figs. 7, 8.) Carapace broadly triangular, usually transverse. Spines of rostrum short or obsolete. Basal antennal joint dilated, with short spines at its distal end. Anterior legs in male usually enlarged. Ambulatory legs not dilated and compressed.

Subgenus MITHRAX, *Leach* (*Teleophrys*, Stimpson). Carapace with the branchial regions not sulcated, sides usually spinose.

Subgenus MITHRACULUS, *White*. Carapace depressed, with shallow smooth interspaces or sulci between the tubercles on the branchial regions, antero-lateral margins tuberculate (anterior legs greatly enlarged). Type *Mithraculus sculptus* (Lamarck).

Scarcely distinct even as a subgenus from *Mithrax*, although of very different external aspect; the characters of the orbital and antennal region are not constant. *Teleophrys* of Stimpson marks the transition from *Mithrax* to *Mithraculus*.

Family IV. PARTHENOPIDÆ. (*Parthénopiens* and *Cancériens* cryptopodes, M.-Edwards).

Eyes usually retractile within the small circular and well-defined orbits; the inferior wall of the orbit is continued to within a very short distance of the front. The antennæ are very slender, the basal joint does not, as in the Periceridæ, constitute a great part of the interior orbital margin, but is very small, and usually does not reach to the front, and with the next joint occupies the narrow hiatus intervening between the front and inner orbital angle.

The structural relationship of this family with the Oxystomata, best evidenced in the genus *Mesorhæa*, has been already adverted to; and there are resemblances also in external characters, such as the lateral extension of the carapace over the ambulatory legs

in *Cryptopodia*, and the form of the anterior legs in certain forms (e. g. *Æthra*), in which they are capable of being closely applied to the body. On the other hand, the structure of the orbits and position of the basilar portion of the antennæ very nearly resembles that of certain Cancroid genera, as *Pilumnus* and *Trapezia*. The Parthenopidæ are related, as already stated, with the typical Oxyrhyncha through *Inachoides* and *Inachus*.

Subfamily 1. PARTHENOPINÆ. (See Plate XIII. figs. 9, 10, 11.)

Carapace equilaterally or transversely triangular or elliptical. Rostrum simple. A strongly marked depression separating the branchial from the cardiac and gastric regions. Anterior legs greatly developed, with the palm trigonous, fingers acute.

§ *Carapace not laterally expanded.*

LAMBRUS, *Leach*. (Plate XIII. fig. 9.) Carapace equilaterally triangular, with the regions convex, tuberculate. Basal antennal joint short and not reaching to the front, the inner orbital hiatus usually occupied by the second joint, which is longer than or as long as the first. Anterior legs with a tuberculated or spinose crest along the upper margin of the palm. Anterior legs usually very long. Ambulatory legs very short, smooth or minutely spinose. Type *Lambrus longimanus* (Linn.).

PARTHENOPE, *Fabricius*. Carapace equilaterally triangular. Basal antennal joint longer than the second, but not reaching the inner orbital hiatus. Anterior legs rather compressed, tuberculated, but not cristated. Ambulatory legs longer, with long spines. Type *Parthenope horrida* (Linn.).

Scarcely distinct as a genus; but it appears better to retain it as a designation for the single species *P. horrida*, than to unite it with *Lambrus*, when the rule of priority would compel the adoption of the generic term *Parthenope* for all the numerous species of the former genus, which have been universally designated as species of *Lambrus*.

* SOLENOLAMBRUS, *Stimpson*. Carapace pentagonal, smooth, convex, with the margins acute. Rostrum short and blunt, or faintly tridentate. Basal joint of antennæ about as long as the second. Pterygostomian regions ridged as in *Heterocrypta*. Anterior legs nearly as in *Lambrus*. Ambulatory legs slender, compressed. Type *Solenolambrus typicus*, Stimpson.

* *MESORHŒA*, *Stimpson*. Resembles *Solenolambrus* in the carapace, legs, pterygostomian and hepatic channels; but the efferent branchial channels meet in the middle of the endostome or buccal cavity, which has a triangular projection and a deep notch in its vertical laminiform wall. The third joint of the outer maxillipedes is produced forward at its internal angle and conceals the palpus. Type *Mesorhœa sexspinosa*, *Stimpson*.

This remarkable genus indicates an approach on the part of the Maioidea to the Oxytomatus crabs, as has already been stated.

§§ *Carapace more or less laterally expanded.*

CRYPTOPODIA, *Milne-Edwards*. Carapace transversely triangular, with the lateral margins greatly produced, and concealing the ambulatory legs, the posterior margin also prolonged backward. Front very prominent. No ridges on the pterygostomian regions. Type *Cryptopodia fornicata* (Fabr.).

HETEROCRYPTA, *Stimpson*. Carapace as in *Cryptopodia*, but without the posterior expansion. A strongly-marked ridge on the pterygostomian region, defining the afferent channel. Type *Heterocrypta granulata* (Gibbes).

ÆTHRA, *Leach*. (Plate XIII. fig. 10.) Carapace transversely oval or elliptical, with the lateral margins produced as in *Cryptopodia*, and dentated. No posterior expansion. No ridge on the pterygostomian region. Type *Æthra scruposa* (Linn.).

This genus, although somewhat resembling *Cancer* and *Etisus* in external form, is much more nearly allied to *Cryptopodia* in the characters of the cephalothorax and antennæ, and must be arranged with that genus, as has been done by *Stimpson* and *S. I. Smith*.

(The genus *Eurynolambrus*, which is placed by *MM. Milne-Edwards* and *Lucas* and by *Dana* with the *Parthenopidæ*, and which in the triangular and expanded carapace has certainly much resemblance to *Cryptopodia*, has really far more affinity with *Cancer* in the form of the orbital and antennal region. The basal joint of the antennæ, as in that genus, is much enlarged, and excludes the flagellum from the orbital hiatus. The front is bilobate; and the anterior legs have not the trigonous form characteristic of *Cryptopodia* and its allies. The lateral expansions of the carapace are far smaller, and do not conceal the ambulatory

legs. I propose, then, to refer this genus to the Cancerinæ, where it marks the transition of that group to the Parthenopidæ.

The genus *Telmessus* of White, which was originally placed by its author among the Plagusiinæ and subsequently assigned to the Maiidæ (Voy. Samarang, Crust. p. 14) has externally some resemblance to *Anaptychus*. In the characters of the orbital and antennal regions, however, it has more affinity with the Cancroid than the Maioid crabs; and its most natural position is perhaps among the Corystoidea, where Dana placed it.)

Subfamily 2. EUMEDONINÆ.

Carapace usually rhomboidal or subpentagonal, with a spine at the junction of the antero-lateral and postero-lateral angles. Rostrum usually bifid or emarginate. Depressions separating the regions of the carapace obscure or non-existent. Anterior legs of moderate length, not trigonous.

§ *Carapace flat and smooth above. Ambulatory legs with all the joints greatly dilated and compressed.*

ZEBRIDA, *White*. Spines of rostrum and lateral spines of carapace large, laminate. Basal antennal joint large and filling the orbital hiatus. Type *Zebrida Adamsii*, *White*.

§§ *Carapace uneven or convex. Ambulatory legs slender.*

***EUMEDONUS**, *Milne-Edwards*. Carapace depressed. Rostrum long and emarginate at its extremity, where the spines are divergent. Anterior legs rather large. Ambulatory legs slightly compressed, with the third joint somewhat cristated. Type *Eumedonus niger*, *Milne-Edwards*.

GONATONOTUS, *Adams and White*. Carapace uneven above. Rostrum broad, lamellate, rounded, and very slightly emarginate or entire at its distal extremity. Anterior legs of moderate size. Ambulatory legs slender, not dilated and compressed. Type *Gonatonotus pentagonus*, *Adams and White*.

CERATOCARCINUS, *Adams and White*. Carapace tuberculated above. Rostrum composed of two slender widely separated spines. Anterior legs of moderate size. Ambulatory legs slender. Type *Ceratocarcinus longimanus*, *Adams and White*.

In this remarkable genus, the inner orbital hiatus is completely

closed and the slender antennæ consequently excluded from the orbit.

HARROVIA, *Adams & White*. (Plate XIII. fig. 11.) Carapace slightly tuberculate, lateral spine small. Front broad, truncated, and divided by three fissures into four lobes, of which the median are truncated and the lateral acute. Anterior legs elongated, ambulatory legs slender. Type *Harrovia albo-lineata*, Adams and White.

This genus was wrongly placed by Adams and White with the Leucosiidæ. By Stimpson it was considered synonymous with *Ceratocarcinus*; but it is as distinct as any other of the group. With the preceding, it appears to constitute almost a connecting link between the Parthenopinæ and the Eriphiidæ (*Trapezia*). As the specimens are dried and almost unique, I have not been able to examine the buccal cavity; but in the allied genus *Gonatonotus* there are clearly-marked longitudinal ridges on the endostome, as in the Eriphiidæ.

APPENDIX.

**GONIOTHORAX*, *A. M.-Edwards*. This genus, which has been described since my paper was read, is allied, according to its author, to *Epialtus* and *Acanthonyx*, but differs in the length of the non-prehensile ambulatory legs and in the structure of the antennal region. The antennæ define the orbits below; their basal joint is small, not reaching to the summit of the antennular fossæ; the two following joints are nearly as thick as the first, the third being remarkably long. Type *Goniothorax ruber*, A. M.-Edwards.

**LEPIDONAXIA*, *Targioni-Tozzetti*. I have not been able to consult the author's recently published 'Report on the Brachyurous and Anomalous Crustacea collected during the voyage of the corvette 'Magenta;'' but, to judge from the description of this genus, quoted by V. Martens in the 'Zoological Record' for 1877, it would seem to be allied to *Hyastenus*, differing, however, in the form of the basal antennal joint, which is dilated and unarmed externally, unidentate posteriorly and in the middle. Type *Lepidonaxia Deflippii*, Targ.-Tozzetti.

PLATYLAMBRUS, *Stimpson*. This generic name was suggested by Stimpson in case it should be found practicable to separate from *Lambrus* the *L. crenulatus*, Saussure, and such allied species

as are characterized by a depressed carapace and excavated pterygostomian and subhepatic regions, this excavation forming, when the chelipedes are retracted, passages to the efferent branchial apertures.

This excavation, however, varies not only in direction and depth, but is traceable in species not otherwise very nearly allied; and I would suggest the following as more convenient subgeneric divisions:—

Subgenus 1. *LAMBRUS*. Carapace subrhomboidal, not produced at its postero-lateral angles over the bases of the ambulatory legs. Anterior legs greatly elongated and spinose (usually more than three times as long as the carapace). Type *Lambrus crenulatus*; Sauss.

Subgenus 2. *PARTHENOPOIDES*, *Miers*. Carapace subtriangular with the posterior margin nearly straight, and produced at the postero-lateral angles over the bases of the ambulatory legs. Anterior legs rarely spinose and of moderate length (rarely exceeding $2\frac{1}{2}$ times the length of the carapace). Type *Parthenopoides massena* (Roux).

This subgenus includes those *Lambri* which approach *Parthenope* in the lesser development of the anterior legs, and includes several species which have been described as members of that genus.

DESCRIPTION OF THE PLATES.

PLATE XII.

- Fig. 1. *Stenorhynchus rostratus* (Linn.). Front of the cephalothorax, dorsal view, showing the laterally projecting eyes and the absence of orbits; $\times$ nearly 3 diameters.
2. Inferior view of the same, showing the slender basal antennal joint and large epistome; $\times$ nearly 3 diam.
 3. *Oregonia hirta*, Dana. Front of the cephalothorax, showing the projecting rim which covers the base of the ocular peduncle and the prominent postocular spine; $\times$ 3 diam.
 4. Inferior view of the same, showing the form of the narrow basal antennal joint and of the epistome; $\times$ 3 diam.
 5. *Xenocarcinus tuberculatus*, White. Inferior view of the front of the cephalothorax, showing the immobile eyes and the form of the basal antennal joint; $\times$ 3 diam.
 6. *Acanthonyx lunulatus*, Risso. Inferior view of the front of the cephalothorax, showing the form of the basal antennal joint and the partial concealment of the eyes beneath the prominent præocular spine; $\times$ 3 diam.

- Fig. 7. *Maia squinado*, Linn. Dorsal view of the front of the cephalothorax, showing the form of the upper orbital wall, which is formed of long spines, beneath which the long and slender eye-peduncles are retractile; natural size.
8. Inferior view of the same, showing the form of the inferior margin of the orbit and of the enlarged basal antennal joint; natural size.
9. *Pisa (Arctopsis) lanata*, Lamk. Dorsal view of the front of the cephalothorax, showing the narrow hiatus in the upper orbital margin and the short eye-peduncle; $\times 2$ diam.
10. Inferior view of the same, showing the hiatus in the lower orbital margin and the basal antennal joint; $\times 2$ diam.

PLATE XIII.

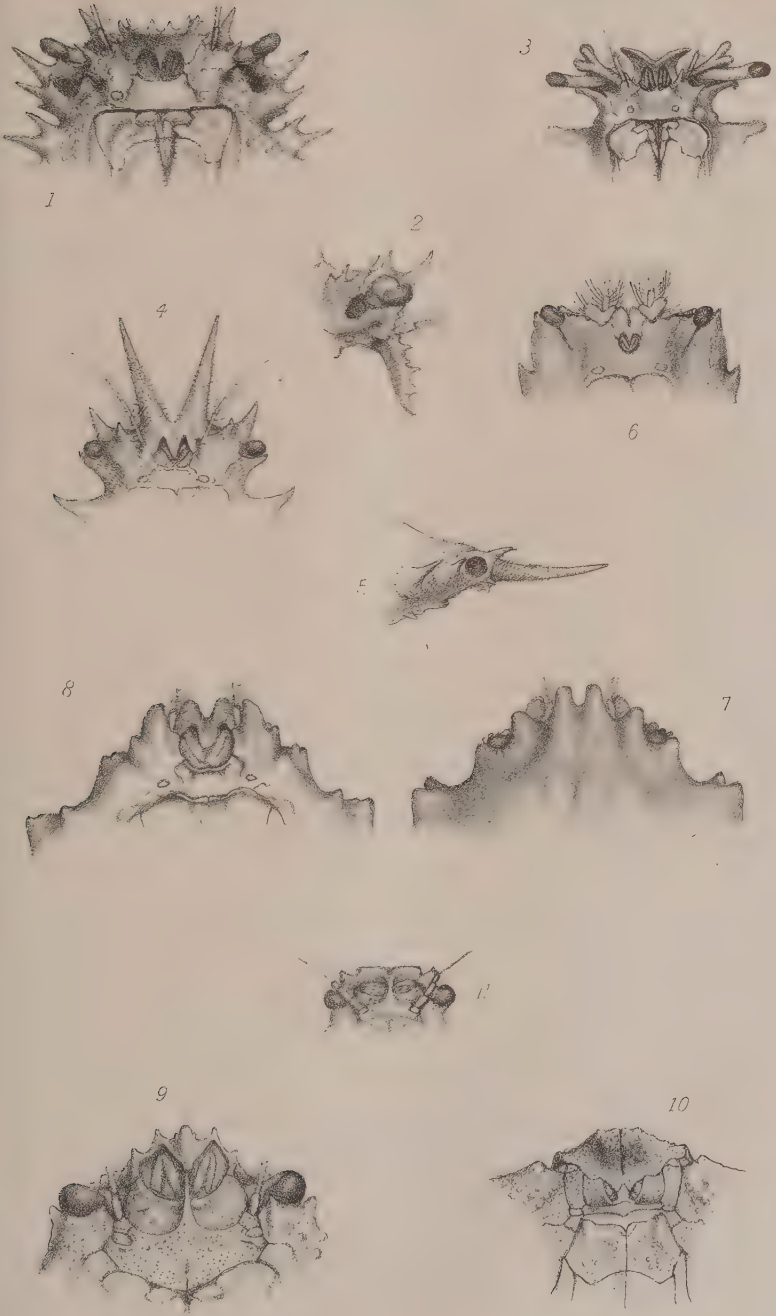
- Fig. 1. *Micippa cristata*, Leach. Inferior view of the front of the cephalothorax, showing the deflexed rostrum, greatly dilated basal antennal joint, and nearly complete orbits; natural size.
2. Lateral view of the orbit and deflexed rostrum; natural size.
3. *Criocarcinus superciliosus* (Herbst). Inferior view of the front of the cephalothorax, wherein the posterior part of the orbit is represented only by the postocular spine, and the anterior part surrounds the laterally projecting eye-peduncle in the form of a tube open below; natural size.
4. *Pericera cornuta*, Latreille. Inferior view of the front of the cephalothorax, showing the short epistome and greatly-developed basal antennal joint; natural size.
5. Lateral view of the orbital cavity (the eye-peduncle being removed) showing its circular form and complete margin; natural size.
6. *Othonia aculeata* (Gibbes). Inferior view of front of cephalothorax, showing the extreme development of the basal antennal joint (which has coalesced with the surrounding parts), the dilated second antennal joint, and obsolescent rostrum; $\times 1\frac{1}{2}$ diam.
7. *Mithrax hispidus*, Herbst. Dorsal view of the front of the cephalothorax, showing the form of the rostrum and orbits; natural size.
8. Inferior view of the same, showing the form of the epistome and basal antennal joint; natural size.
9. *Lambrus macrochelos*, Herbst. Inferior view of the front of the cephalothorax, showing the small antennæ inserted in the hiatus between the inner orbital angle and the front; $\times 2$ diam.
10. *Ethra scruposa* (Linn.). Similar view of the front of the cephalothorax; natural size.
11. *Harrovia albolineata*, Ad. & White. Similar view of the front of the cephalothorax; $\times 3$ diam.
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STRUCTURE OF ORBITAL AND ANTENNAL REGIONS
OF THE MAIROID CRABS. (OXYRHYNCHA)

C. Berjeau lith.

Hanhart imp.



STRUCTURE OF ORBITAL AND ANTENNAL REGIONS
OF THE MAIROID CRABS. (OXYRHYNCHA).

C. Berjean lith.

Hanhart imp

*From the author
16 Oct. 79*

ON A
COLLECTION OF CRUSTACEA
MADE BY
CAPT. H. C. ST. JOHN, R.N.,
IN THE
COREAN AND JAPANESE SEAS.

BY
EDWARD J. MIERS, F.L.S., F.Z.S.

PART I.
PODOPHTHALMIA.

WITH AN APPENDIX

BY
CAPT. H. C. ST. JOHN, R.N.

[*From the* PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF
LONDON, January 14, 1879.]

(Plates I.-III.)

The collections of Crustacea made by Capt. H. C. St. John while engaged in surveying the Japanese coasts between the years 1870 and 1877 have been presented by Dr. J. Gwyn Jeffreys, F.R.S., to the Trustees of the British Museum, and are of so much interest, both from the geographical distribution of the species and on account of the many novelties collected, that I have thought it desirable to bring an account of them before the Society. The specimens were nearly all obtained by dredging; and Capt. St. John has furnished an interesting account of the mode adopted by him in collecting and separating the specimens, which is printed below as an Appendix. But few of the larger and well-known littoral species, which are so well described and figured by De Haan in his standard work upon the Crustacea of Japan (in Siebold, 'Fauna Japonica,' 1833-50), are represented in the collection.

Comparatively little was known of the Crustacean fauna of the deeper waters of this region until the publication, in 1857-60, of a series of papers by the late Dr. W. Stimpson, the eminent American carcinologist, on the Decapoda collected by the U.S. Expedition to the North Pacific under Commanders C. Ringgold and J. Rodgers, in the 'Proceedings of the Philadelphia Academy of Sciences,' which contain short Latin diagnoses of a large number of new species (many of them obtained at considerable depths), and in which also a considerable number of species previously described by Milne-Edwards, Dana, Adams and White, and others are added to the Japanese fauna. It is much to be regretted that no fuller account of these collections should ever have appeared, and that Stimpson's preliminary report did not extend beyond the Decapoda. As Capt. St. John's collections were made in the same region, many of Stimpson's species occur in them; and in their determination I have been greatly aided by comparing them with a series of specimens from the Japanese Seas, named by Dr. Stimpson himself, and presented some years ago by the Smithsonian Institution to the British Museum.

It is remarkable, under the circumstances, that the present collection should contain so many forms which are new to science, while so many of Stimpson's species still remain *desiderata* to the national collection; and this goes far to prove that a rich harvest will yet reward the collector of marine Invertebrata in the Japanese region, and that even more interesting results may be expected in many regions where no dredging-operations have yet been attempted. The

careful manner in which the exact particulars regarding the locality, depth, and, in some cases, the temperature of the water have been recorded by Capt. St. John gives additional scientific value to the present collection; and although it is to be regretted that the labels belonging to a few of the bottles had unfortunately been washed off and lost before the collection was received by the Trustees, yet Capt. St. John assures me that all these specimens were collected in or near the Korean Straits. The only species not obtained in these seas or in the Japanese region is the remarkable Crab *Gonatonotus pentagonus* of Adams and White, which was dredged in the Javan sea, near Billiton Island, at a depth of 12 fathoms.

In the present communication 64 species or well-marked varieties belonging to the Podophthalmia are noticed; and of these 26 are apparently new to science, besides which there are several which for different reasons I have refrained from designating by a specific name. The names and the families to which they appertain are given in the systematic list which follows, where also I have noted the localities and the geographical range, when known.

In a second paper I hope to describe the remainder of the species collected, which belong chiefly to the orders Amphipoda and Isopoda, and to the Cirripedia and Pycnogonida, and are not less interesting than the Podophthalmia.

List of Species described in the present paper.

PODOPHTHALMIA.

DECAPODA.

BRACHYURA.

OXYRHYNCHA V. MAIOIDEA.

~~MAIIDE.~~ *Maioidea*

Pugettia quadridens (De Haan). Korean Channel, Japan, Hong Kong: p. 23.

P. incisa (De Haan). Korean Channel, Japan: p. 23.

Oregonia hirta, Dana. Japan, California: p. 24.

Pleistacantha sancti-johannis, gen. and sp. n. Japanese seas (North Pacific coast): p. 24.

Achæus spinosus, n. Korean Channel: p. 25.

A. tuberculatus, n. Korean Channel: p. 25.

Hyastenus diacanthus (De Haan). Japan, Korean Channel, Australian and Indo-Malayan seas: p. 26.

H. (Chorilia) japonicus, n. Japanese seas: p. 27.

Doclea orientalis, n. Kunasiri Isl.?, Yesso Island: p. 28.

~~PARTHENOPTIDE.~~ *Parthenoptidae*

Gonatonotus pentagonus, Ad. & White. Javan Sea, Borneo, North-east Australia: p. 29.

Lambrus intermedius, n. Korean Channel: p. 29.

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CYCLOMETOPA v. CANCROIDEA.

CANCRIDÆ.

Actea granulata, Audouin. Japanese seas, Indo-Pacific region : p. 30.

Actæodes tomentosus (M.-Edw.), var. Goto Islands, Indo-Pacific region : p. 30.

Leptodius exaratus (M.-Edw.), var. Corean Channel, Japanese seas : p. 31.

ERIPHIIDÆ.

Pilumnus hirsutus, Stm. Corean Channel, North-China seas : p. 31.

P. dehaanii, n. Gulf of Yedo : p. 32.

PORTUNIDÆ.

Thalamita sima, M.-Edw. Japanese seas, Indo-Pacific region : p. 32.

Goniosoma ornatum, A. Edw. Seas of Eastern Asia : p. 33.

G. variegatum (Fabr.). Indian and East-Asian seas : p. 33.

Portunus corrugatus (Pennant). British seas, Mediterranean, Red Sea, Japan : p. 33.

CORYSTIDÆ.

Trichocarcinus dentatus, n. Japan, Corean Channel : p. 34.

T. affinis, n. Corean Channel : p. 35.

Telmessus acutidens (Stm.). Japanese seas : p. 36.

CATOMETOPA v. GRAPSOIDEA.

MACROPHTHALMIDÆ.

Gelasimus lacteus, De Haan. Japanese and Corean seas : p. 36.

GRAPSIDÆ.

Heterograpsus longitarsis, n. Japanese and Corean seas : p. 37.

Platygrapsus depressus (De Haan), junr. Chinese, Japanese, and Corean seas : p. 37.

Helice tridens, De Haan. Seas of Japan and China : p. 38.

Leiophorus planissimus (Herbst). Indo-Pacific and Atlantic region : p. 38.

CARCINOPLACIDÆ.

Heteroplax? nitidus, n. Corean Channel : p. 39.

RHIZOPIDÆ.

Typhlocarcinus villosus, Stm. Corean Channel, Hong-Kong : p. 40.

OXYSTOMATA v. LEUCOSIIDÆ.

LEUCOSIIDÆ.

Leucosia hamatosticta, Ad. & White, var. Corean Channel, Kagosima, "Eastern seas : " p. 40.

Pseudophilyra tridentata, gen. and sp. n. Corean Channel : p. 41.

Philyra, sp. Matoya : p. 41.

Myra dubia, n. Corean Channel : p. 42.

Ebalia rhomboidalis, n. Corean Channel : p. 42.

E. minor, n. Corean Channel: p. 43.

E. bituberculata, n. Japanese seas (North Pacific coast): p. 43

Cryptocnemus pentagonus, Stm. Corean Channel, Gulf of Kago
sima: p. 43.

Arcania globata, Stm. Corean Channel, China Sea, "Eastern
seas:" p. 44.

A. orientalis, n. Corean Channel, Japanese seas (North Pacific
coast): p. 44.

ANOMURA.

DROMIDEA.

DROMIIDÆ.

Cryptodromia, sp. Japanese seas (North Pacific coast): p. 44.

HOMOLIDÆ?

Paratymolus vubescens, gen. and sp. n. Matoya: p. 45.

RANINIDEA.

Ranina serrata, Lam. Japan, Indo-Pacific region: p. 46.

Lyreideus tridentatus, De Haan? Japan, Kada Bay: p. 46.

PORCELLANIDEA.

Porcellana spinulifrons, n. Corean Channel: p. 46.

Pachycheles stevensii, Stm. Japanese and Corean seas: p. 47.

LITHODIDEA.

Hapalogaster dentatus (De Haan). Japan, Goto Islands: p. 47.

Cryptolithodes expansus, n. North Japan: p. 47.

PAGURIDEA.

Eupagurus cavimanus, n. Japanese seas (Tsugar Straits): p. 48.

Pomatocheles jeffreysii, gen. and sp. n. Corean and Japanese seas:
p. 49.

GALATHEIDEA.

Galathea orientalis, Stm. Corean Channel, Hong Kong (Ly-i-
moon Straits): p. 51.

Munida japonica, Stm. Corean Channel, Gulf of Kagosima: p. 51.

MACRURA.

THALASSINIDEA.

GEBIIDÆ.

Gebia major, De Haan. Japan, Katsura, and Kada Bay: p. 52.

CARIDEA.

CRANGONIDÆ.

Paracrangon echinatus, Dana. Yedo Island, California, Puget
Sound: p. 52.

ALPHEIDÆ.

Alpheus bisincisus, De Haan. Japan, Katsura, Corean Channel : p. 53.

A. japonicus, n. Japanese seas (North Pacific coast) : p. 53.

A. kingsleyi, n. Japanese seas (North Pacific coast) : p. 54.

A. gracilipes, Stm.? Corean Channel, Tahiti : p. 55.

Rhynchocyclus planirostris (De Haan). Japan, Ly-i-moon Straits, near Hong Kong : p. 55.

Hippolyte leptognatha, Stm. Japan, Gulf of Yedo, Hakodadi : p. 56.

Pandalus gracilis, Stm. Corean Channel, Gulf of Hakodadi : p. 56.

PENÆIDEA.

PENÆIDEA.

Penæus affinis, M.-Edw. Japanese and Corean seas, Indo-Pacific region : p. 56.

CUMACEA.

Heterocuma sarsi, gen. and sp. n. Corean and Japanese seas : p. 58.

H. sarsi, var. *granulata*, n. Corean Channel : p. 58.

Remarks on the Geographical Distribution of the Species.

The Crustacean fauna of Japan includes many species of restricted range and peculiar to the seas of Eastern Asia, besides many of the common and widely-spread littoral Indo-Pacific forms; but it also presents affinities with the European and especially the Mediterranean fauna, and that of the west coast of the American continent. As illustrating the European affinities I may note the occurrence, both in the South-European and Japanese seas, of such well-known genera as *Achaus*, *Ebalia*, and *Eupagurus*, and the remarkable genus *Latreillia* (of this latter I have seen no specimens), and of the *Portunus corrugatus*, Pennant, originally described from the British coast; moreover the *Penæus distinctus*, De Haan, is either identical with or closely allied to the Mediterranean *Solenocera siphonocera*, Philippi, and in the present collection occur species of the genera *Mara* and *Pycnogonum*, scarcely distinct from the well-known European *M. truncatipes* and *P. littorale*. The last-mentioned is a boreal species; but the instances above given (and others which might be cited) show that the relationship which does exist is not confined to forms which may have made their way from Europe to Japan along the northern shores of Asia.

The affinity of the Japanese with the Western-American Crustacean fauna is similarly evidenced by the existence of many genera common to the shores of both regions, the species being either identical or very closely allied, so closely, indeed, that further comparative study might show the relationship is even more near than is now suspected. Instances in the present collection are the genera *Pugettia*, *Oregonia*, *Trichocarcinus*, *Telmessus*, *Heterograpsus*, *Hapalogaster*, *Pachycheles*, *Paracrangon*, *Rhynchocyclus*, among the Podophthalmia.

Many of the genera thus common to the two regions are scarcely

found elsewhere, and are peculiarly characteristic of the Pacific coasts of America. Some, having a boreal range (*Echidnocerus*, *Hapalogaster*), evidently pass from one continent to the other *viâ* Behring's Straits; but instances are not wanting (although rare) of forms which have never been shown to have a boreal range occurring on both coasts of the Pacific. An example occurs in the present collection in the curious Shrimp *Paracrangon echinatus*, Dana, in the case of which I have satisfied myself, by actual comparison, of the identity of examples from Puget Sound, California, and Yedo Island. *Hyastenus* (*Chorilia*) *japonicus*, and *Telmessus acutidens*, Stm., may, upon further comparison, prove to be identical with their American congeners.

BRACHYURA.

OXYRHYNCHA vel MAIOIDEA.

MAIDÆ.

PUGETTIA QUADRIDENS.

Menæthius quadridens, De Haan, Faun. Japon. Crust. p. 97, pl. xxiv. fig. 2, ♂ (*Halimus*), and pl. G (1839).

Pugettia quadridens, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 219 (1857).

This species is very closely allied to the *Pugettia gracilis*, Dana (U.S. Expl. Exp. xiii. p. 117, pl. iv. fig. 3, 1852), from the Californian coast; but the lateral lobes or expansions of the carapace are less broad and triangular in shape, and more acute at the extremity. In the females the carapace is more convex than in the males, with the hepatic regions more convex.

Otarranal, $5\frac{1}{2}$ fathoms, lat. $43^{\circ} 12'$ N., long. $141^{\circ} 1'$ E.; Isenomi Straits, low-water mark; Corean Channel, lat. $33^{\circ} 12\frac{1}{2}'$ N., long. $129^{\circ} 5'$ E., 9 fathoms. Males, females, and young were collected.

Stimpson's specimens were from Simoda, Japan, and Hong Kong.

PUGETTIA INCISA.

Menæthius incisus, De Haan, Faun. Japon. Crust. p. 98, pl. xxiv. fig. 3, ♀ (*Halimus*), and pl. G (1839).

Pugettia incisa, Stm. Proc. Ac. Nat. Sci. Phil. p. 219 (1857).

Three specimens, males, all of small size, were obtained of this species, which differs from its congeners in the auriculiform shape of the first pair of lateral expansions of the carapace, in which it exhibits some affinity with the genera *Hyas* and *Hyastenus*, from the first of which it differs in the slender divergent horns of the rostrum, and from the second in the far less perfectly defined orbits. Although the basal joint of the antennæ is somewhat broader, the structure of the antennal and orbital regions is essentially that of *Pugettia*.

Gulf of Yedo (bottom soft mud and hard sand); Corean Channel, lat. $33^{\circ} 10'$ N., $129^{\circ} 12'$ E., at 36 fathoms.

This and the preceding species were previously unrepresented in the British-Museum collection.

OREGONIA HIRTA ?

? *Oregonia hirta*, Dana, Amer. Journ. Sci. and Arts (ser. 2), xi. p. 270 (1851); U.S. Expl. Exp. xiii., Crust. i. p. 107, pl. iii. fig. 3 (1852).

Two specimens of an *Oregonia* were collected, both females, the larger and mature example densely overgrown with sea-weed. These agree in almost every respect with specimens of *Oregonia hirta*, from California (Puget's Sound), in the collection; but the legs are rather more robust, and the branchial regions more convex. The examination of males might show that they belong to a distinct species; for the present, however, they cannot be regarded as distinct.

Japan, Cape Blunt, lat. $41^{\circ} 41'$ N., long. $141^{\circ} 0'$ E. (depth 35 fathoms).

PLEISTACANTHA, gen. nov.¹

Carapace triangular, convex, and spinose. Rostrum long and slender, composed, as in *Oregonia*, of two spines, which are in contact with one another to near their extremities. Eyes laterally projecting. Orbits not defined, the inferior walls wanting, the superior and posterior represented by two or three spines. Antennules long; interantennular septum with a prominent spine projecting downward. Antennæ with the basal joint extremely slender and armed with three spines; the flagellum long, reaching almost to the extremity of, and visible in a dorsal view at, the side of the rostrum. Ischium (or second) joint of the outer maxillipeds longer than the merus-joint, which has a short spine at its antero-external angle; the exognath very slender. Legs, as in *Egeria*, very long; the anterior pair robust, with the fingers acute and meeting near their apices along their inner margins, but leaving an *hiatus* at base when closed. The ambulatory legs are slender, and diminish successively in length to the last pair; their terminal joints are long, slender, and densely hairy. The male postabdomen is 6-jointed, the inflexed portion oblong, the terminal joint transverse and rounded at its distal extremity.

This genus must be placed near *Oregonia*, with which it is nearly allied in the structure of the rostrum and orbital and antennal region; but it differs in the convex and spinose carapace and greatly elongated legs, which gives it more the aspect of *Egeria*, and would necessitate its being placed among the *Macropodiens* in Milne-Edwards's arrangement. From *Egeria* it differs in the structure of the orbital and antennal region, &c.

PLEISTACANTHA SANCTI-JOHHANNIS, sp. n. (Plate I. fig. 1.)

Carapace covered with very numerous small spines of uniform size; interspersed with these are longer spines, of which three are placed in a transverse series on the front and one at the back of the gastric region, two on the cardiac, two on the intestinal and about three on each branchial region; there are also several longer spines placed behind the eyes and on the sides of the branchial regions. Rostrum

¹ *πλειστος*, superl. of *πολύς*, many; and *ἀκανθα*, a spine.

nearly half as long as the carapace, the spines of which it is composed divergent near their extremities, and armed on their undersides with two or three spinules. Anterior legs with the arm and wrist covered with small spines; arm with a strong conical curved spine on the upper margin at its distal extremity; palm robust, about as long as the arm, with fewer spinules arranged in longitudinal series; fingers naked. Ambulatory legs with numerous small spinules; the terminal joints, and in the last pair the two preceding joints are without spines and hairy. Length of carapace to base of rostrum $\frac{3}{4}$ inch, breadth about $\frac{7}{12}$ inch; length of anterior leg $3\frac{1}{8}$ inches.

This species was obtained at a depth of 63 fathoms, in October 1874, in lat. $34^{\circ} 1' N.$, long. $136^{\circ} 20' E.$

A single male individual was collected. As it is certainly one of the most striking novelties in the collection, I have much pleasure in dedicating it to its indefatigable discoverer, Capt. H. C. St. John, R.N.

ACHÆUS SPINOSUS, sp. n.

Carapace triangular, narrowed behind the orbits, as in *Achæus* (*Inachus*) *lorina*, and armed with six spines above, viz. one on the gastric, one (which is bilobate) on the cardiac, and two on each branchial region; there are also two or three small spines or tubercles on the sides of the body, beneath the hepatic and branchial regions. The rostrum, as in all the species of the genus, is very small and bilobate. Eye-peduncles robust, laterally projecting and armed with a strong tubercle in front. Anterior legs (in the male) robust; arm and wrist with a few scattered granules above; palm swollen, with about six spinules on the upper margin and a few small granules on the lower margin, near its base; fingers acute, with a wide hiatus at base when closed, both the fingers with a strong tooth on their inner margins near the base; both are faintly cristated on their outer margins. Ambulatory legs very slender, the terminal joint of the last pair strongly falcated. Terminal postabdominal segment subtriangular. Length $\frac{1}{3}$ inch, breadth $\frac{1}{4}$ inch.

A single specimen (male) was collected at a depth of 30 fathoms, in lat. $34^{\circ} 10' N.$, long. $136^{\circ} 47' E.$

The nearest ally of this species seems to be the *Achæus lorina* (*Inachus lorina*, Ad. & White, Zool. Samarang, Crust. p. 3, pl. ii. fig. 2, 1848), from Mindanao, from which it differs in the number and disposition of the spines of the carapace. Both of these species externally resemble *Inachus*, but differ in the absence of defined orbits and in the falcated posterior legs, on account of which they must be referred to *Achæus*.

ACHÆUS TUBERCULATUS, sp. n.

There are several specimens of a species of *Achæus* in the collection, which are all unfortunately in an imperfect condition, the anterior and most of the ambulatory legs being absent. The carapace is triangular and broader than in the preceding species, without spines, not constricted behind the interocular region; the regions are con-

vex and well defined; and there is a very prominent conical tubercle upon the cardiac region which is not bilobate, also a broad lobe or tubercle upon the hepatic region. The eye-peduncles are smooth; the posterior legs have the last joint but slightly falcated. The postabdomen of the male is broader than in the preceding species, the terminal segment transverse. Length (of male)-nearly $\frac{5}{12}$ inch, breadth nearly $\frac{1}{3}$ inch.

Specimens were collected at a depth of 36 fms., in lat. $33^{\circ} 10' N.$, long. $129^{\circ} 12' E.$; and there are others without definite locality attached.

This species resembles the *Achæus lacertosus* of Stimpson (Proc. Ac. Nat. Sci. Phil. p. 218, 1857), from Australia, Port Jackson, in the distinctly defined regions of the carapace, the presence of an hepatic lobe, and the smooth eye-peduncles, but differs in the very prominent tubercle or blunt spine on the cardiac region, which is present in both sexes, whereas Stimpson, in his description of *Achæus lacertosus*, says, "*superficie lævi spinis carente.*" I must therefore regard it as distinct. Stimpson's species was from Port Jackson, Australia.

Achæus japonicus, De Haan (Faun. Jap. Crust. p. 99, pl. xxix. fig. 3, 1839), is described and figured as devoid of spines on the carapace, and the eye-peduncles as being 4-spinulose; there is no hepatic lobe.

HYASTENUS DIACANTHUS.

Naxia diacantha, De Haan, Faun. Japon. Crust. p. 96, pl. xxxiv. fig. 1, and pl. G (1839).

Hyastenus diacanthus, A.M.-Edw. Nouv. Archiv. Mus. Hist. Nat. viii. p. 250 (1872).

Hyastenus verreauvii, A.M.-Edw. l. c. p. 250 (1872).

A single male specimen of this common inhabitant of the Japanese seas was obtained at Ousima, Japan, in 9 fathoms of water on a sandy bottom.

Two other specimens of this genus are in the collection; the first, a small female specimen, was collected in lat. $33^{\circ} 4' N.$, long. $129^{\circ} 18' E.$, at a depth of 23 fathoms. All the limbs are unfortunately missing. It differs in the much greater divergence of the horns of the rostrum, and very probably belongs to a distinct species; but, on account of its mutilated state, I refrain from describing it as such.

In the second, the horns of the rostrum are more than half the length of the carapace and but slightly divergent; the carapace is convex, narrower and more elongated than in *Hyastenus diacanthus*, and without any spines or tubercles, and is covered with a very short close pubescence.

This specimen is also an immature female, and was obtained at a depth of 18 fathoms, near Cape Sima. It would not be advisable to make this the type of a new species by giving it a distinct appellation; but it is distinguished from its nearest ally, *H. diacanthus*, by the total absence of the lateral epibranchial spines, which are present, although very small, in examples of *H. diacanthus* of the same size.

HYASTENUS (CHORILIA) JAPONICUS, n. sp. (Plate I. fig. 2.)

Carapace triangular, rounded behind, with the regions separated by well-marked depressions, and covered with small distant tubercles; of these there are about eight on the gastric and each branchial region, one or two on the hepatic and genital, and one larger on the intestinal region; the cardiac region is very convex. There is a spine on the side of each branchial region. The horns of the rostrum are straight, not half as long as the carapace, and more divergent than in *C. longipes*. On the pterygostomian regions, and on the sides of the carapace, there is a series of small tubercles. The anterior legs (in the adult male) are robust, the arm granulated and ridged on its under, inner, and outer sides, granulated above, and with two spines near its proximal extremity on its upper and two or three on its under surface; wrist granulated and ridged on its upper and outer surface; palm smooth, compressed, acutely carinated above; fingers smooth, denticulated on their inner margins near their apices, the upper with a strong tooth near its base; when closed, they have a wide hiatus at base. The ambulatory legs are slender, smooth, diminishing successively in length from the first to the last; the terminal joints almost immobile and bent at right angles to the preceding. Length of carapace of an adult male about 1 inch to base of rostrum; greatest breadth about $\frac{5}{8}$ inch.

A good series, including males, females, and young, were collected at a depth of 100 fathoms, in lat. $41^{\circ} 40'$ N., long. $141^{\circ} 10'$ E.

The description was taken from an adult male. In the females and younger animals several differences are remarked; notably, the anterior legs are much slenderer, legs granulated and ridged, the fingers nearly straight, without a hiatus and strong tooth at base.

The nearest ally of this species is unquestionably the *C. longipes* of Dana (U.S. Expl. Exp. Crust. i. p. 91, pl. i. fig. 5), from the coast of Oregon. The arrangement of the tubercles is nearly the same; but the one now described differs in its shorter, more divergent rostral spines, the shorter spines upon the basal joint of the antennæ, and in the arms never being spinulose along the whole of their upper surface, &c., and must be regarded, at least provisionally, as distinct. There is very little hair on the front and sides of the carapace and rostrum; and the hands are nearly naked.

Chorilia scarcely differs generically from *Hyastenus*, the structure of the orbits and antennal region and the characteristic length of the first pair of ambulatory legs being the same in both. It may be convenient, however, to retain the name as a subgeneric division including those species of *Hyastenus* in which the carapace is *tuberculated and uneven above*—e. g., the present species, *Chorilia longipes*, and the *Hyastenus oryx* and *verrucosipes* of White.

DOCLEA.

The genera *Libinia*, *Libidoclea* and *Doclea* constitute, in Dana's arrangement, a natural group, characterized by their *very convex and orbiculate or shortly pyriform and tuberculated or spinose carapace*

and *emarginate rostrum*. It is extremely difficult to find reliable characters by which to define the genera, as the species pass into one another by almost insensible gradations. At one end of the series are those which belong undoubtedly to the genus *Libinia*, in which the carapace is triangulate rather than orbiculate, with a distinct supra-ocular tooth, the rostrum prominent, with the spines coalescent and divergent only toward the apex, which thus appears notched, the orbits circular and well defined, with usually a single closed fissure above, the basal joint of the antennæ moderately dilated, and the legs usually of moderate length, the first pair rather slender in the male. At the opposite extremity of the series are the species of *Doclea* in which the carapace is orbiculate in outline, the rostrum very short, the supraocular spine absent, the basal joint of the antennæ narrower, the orbits scarcely defined at all below, the legs usually very long, those of the first pair in the male short, with the palm dilated. The genus *Libidoclea* of Milne-Edwards and Lucas is somewhat intermediate between the two former, having the triangulate carapace, prominent rostrum, dilated basal antennal joint of *Libinia*, with the incomplete orbits and long legs of *Doclea*; the typical species, *L. granaria* (Edw. & Luc. in D'Orbigny's Voy. Amér. Mérid. vi. Crust. p. 8, pl. iii. fig. 1 & pl. iv. fig. 1, 1845), from Valparaiso, possesses an additional character in the existence of a notch on the anterior margin of the third joint of the outer maxillipeds; and the tooth in the middle of the outer margin of the basal joint of the antennæ is very strong; the former of these fails, however, in the *Libidoclea coccinea* of Dana (U.S. Expl. Exp. xiii. Crust. p. 88, pl. i. fig. 3), from Patagonia, which also has a shorter rostrum. In certain species of *Libinia* (*L. emarginata*) there is a small blunt tooth on the outer margin of the basal antennal joint. There appears, then, to be no alternative between restricting the genus *Libidoclea*, by adopting the single character of the emarginate third joint of the outer maxillipeds, or extending its definition until it shall include all the species intermediate between the two older genera. The former is perhaps the preferable course, as, if the latter were adopted, it would be impossible to assign any definite characters to the genus.

DOCLEA ORIENTALIS, sp. n. (Plate II. fig. 1.)

The carapace is convex and subpyriform, with six tubercles in the middle line, of which the first three are on the gastric, two (one more elevated) on the cardiac, and one on the intestinal region; none of these are large and spiniform. There are two prominent tubercles on the lateral anterior margins, one of them placed at some distance behind the orbits, and one on the sides of the branchial region. There are four small tubercles on the front of the gastric region, forming, with the first of the median series, a figure $\begin{smallmatrix} \cdot & \cdot \\ \cdot & \cdot \end{smallmatrix}$, seven or eight on the branchial region, on each side, and three on the pterygostomial region. The rostrum is short, but little longer than broad, and notched to its middle. The orbits have a supraocular tooth, a wide hiatus above, and two fissures below. The basal joint of the antennæ is rather

broad, with an obscure tooth on its outer margin. Anterior legs in the female small; hands compressed, and fingers straight; the ambulatory legs short, those of the first pair not much exceeding in length the greatest breadth of the carapace. Length of carapace and rostrum 1 inch $2\frac{1}{2}$ lines, breadth $11\frac{1}{2}$ lines.

Two specimens, females, were obtained, one at Kunashir (Kunasiri Island?), N. Japan, at a depth of 11 fathoms, bottom small stones; the other from the N.E. coast of Yezo Island.

The nearest ally of this species seems to be the *Doclea gracilipes* of Stimpson (P. Ac. Nat. Sci. Phil. p. 216, 1857), from Hong-Kong, from which it differs in the tuberculation of the carapace and very short anterior legs.

Streets, in a notice of the genus *Libinia* (P. Ac. Nat. Sci. Phil. p. 106, 1870), has described a new species, *L. rhomboidea*, from the East Indies, which may easily be distinguished from the present by the existence of strong spines on the branchial regions and lateral margins.

Another Asiatic species is the *Libinia bidentata*, A. M.-Edw. (Journ. Mus. Godeffroy, i. pt. 4, p. 77, 1873), from the Amoor, which has fewer spines upon the surface of the body. Several *Doclea* have also been described by Bleeker (Acta Soc. Sci. Indo-Neerl. ii. pp. 7-15, 1857), from the Indian archipelago; but none have any near affinity with *Libinia orientalis*.

PARTHENOPIDÆ.

GONATONOTUS PENTAGONUS.

Gonatonotus pentagonus, Ad. & White, P. Z. S. 1847, p. 58; Zool. Samarang, Crust. p. 33, pl. vi. fig. 7 (1848).

Javan Sea, near Billiton Island, lat. $3^{\circ} 21' S.$, long. $108^{\circ} 39' E.$ Dredged at a depth of 12 fathoms.

The single specimen collected is a male, and differs from the female from Borneo, figured by Adams and White, only in the greater length and strength of the anterior legs; the postabdomen is seven-jointed and narrow. There are two young specimens of this species, from reefs on the N.E. coast of Australia, in the British-Museum collection.

This is the only species of Crustacean collected elsewhere than in the Japanese and Corean seas.

LAMBRUS INTERMEDIUS, sp. n.

Carapace triangular, almost destitute of tubercles above, and without large spines on the margins; on the upper surface are three elevated ridges, one on the gastric and cardiac, and one on each branchial region; the median ridge is marked with about four obscure tubercles; the branchial ridges are obscurely granulated; and on the sides of the branchial regions are seven to eight small triangular marginal teeth, which under a lens are seen to be denticulated; the last of these is the largest; on the posterior margin are seven small distant tubercles. There is an elongate depression between the eyes. The rostrum is triangular, smooth and acute; the anterior legs are of moderate length

(for a species of this genus); the arm with a longitudinal line of granules on its anterior and posterior margins and on its upper surface; the wrist nearly smooth; the hand trigonous, smooth on its three faces, with a line of small tubercles or granules on its outer and inner margins; of these about four on the outer margin are somewhat larger and equidistant; all the tubercles of the anterior legs are seen under a lens to be themselves granulated; the mobile finger has three or four spines on its upper margin; the ambulatory legs are very small and compressed; the margins of the merus-joints of the last two pairs are granulated. Length about $\frac{1}{2}$ inch, greatest breadth about $\frac{7}{12}$ inch.

Corean seas (no exact particulars regarding the locality). One male individual collected.

This species belongs to the same group as the *L. lamellifrons*, Ad. & Wh., *L. gracilis*, Dana, and *L. affinis*, A. M.-Edw. From the latter (of which there is a large series from the Javan and Indian seas in the British-Museum collection) it differs in the much fewer tubercles of the carapace and arms, which are less rounded, and from the two former in the much greater breadth of the carapace behind the orbits, and the absence of spines on the outer margin of the hands, &c.

CYCLOMETOPA vel CANCROIDEA.

CANCRIDÆ.

ACTÆA GRANULATA.

Cancer granulatus, Audouin, Explic. Planches, p. 87, de Savigny, Egypte, Atlas, Crust. pl. vi. fig. 2 (1809).

Cancer savignyi, M.-Edw. Hist. Nat. Crust. i. p. 378 (1834).

Actæa granulata, De Haan, Faun. Japon. Crust. p. 18 (1835); A. M.-Edw. Nouv. Archiv. Mus. Hist. Nat. i. p. 275 (1865).

? *Actæa pura*, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 32 (1858).

A small male example is in the collection without definite locality attached. This species appears to be common in the Indo-Malayan, Australian, and Japanese seas; and its range extends to the Red Sea, Mozambique, and the Mauritius.

ACTÆODES TOMENTOSUS, var.

Zozymus tomentosus, M.-Edw. Hist. Nat. Crust. i. p. 385 (1834).

Actæodes tomentosus, Dana, Crust. U.S. Expl. Exp. xiii. (i.) p. 197 (1852).

Actæa tomentosa, A. M.-Edw. N. A. Mus. H. N. i. p. 262 (1865).

In this variety the carapace is very broad in proportion to its length, the granules with which it is covered small and very numerous, the anterior areolets scarcely, and the posterior (*e. g.* the cardiac) not at all, distinguishable; the colour is dull red. Length rather more than $\frac{1}{3}$ inch, breadth $\frac{7}{12}$ inch.

Collected at the Goto Islands, at low-water mark.

The two males and female collected, on account of the indistinguishability of the areolets, present a very different appearance both

from the typical *A. tomentosus* and the species or variety designated *A. affinis* by Dana (U.S. Expl. Exp. xiii. Crust. i. p. 198, pl. xi. fig. 3), from the Paumotu or Society Islands; yet I find no characters which would justify me in considering them a distinct species.

LEPTODIUS EXARATUS, var.

Chlorodius exaratus, A. M.-Edw. Hist. Nat. Crust. i. p. 402 (1834).

Xantho affinis, De Haan, Faun. Japon., Crust. p. 48, pl. xiii. fig. 8 (1835).

Two very small specimens of a *Leptodius*, without particulars regarding locality, appear to belong to a well-marked variety of the common *L. exaratus*, or even to a distinct species. As the specimens are immature, it is not advisable to give them a distinct specific name. The carapace is depressed, the areolets scarcely marked and somewhat eroded towards the front and antero-lateral margins; the three posterior antero-lateral marginal teeth are small and subacute, the others obsolete; the frontal lobes are broad, with the anterior margin straight, and they are separated by a very small median notch. The anterior legs have the wrist and hand very rugose on their upper and outer surfaces; the ambulatory legs somewhat dilated and compressed, and the tarsal joints very narrow. Length 3 lines, breadth $4\frac{1}{2}$ lines.

ERIPHIIDÆ.

PILUMNUS HIRSUTUS.

Pilumnus hirsutus, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 37 (1858).

The large series collected agree in all respects with Stimpson's diagnosis. The outer orbital spine is smaller than the three spines of the antero-lateral margin, which are acute. The larger hand (which is usually the right, but in some individuals the left) is granulated on its upper, and in younger specimens more minutely on its outer, surface; the lower finger is usually in a straight line with the lower margin of the hand. The smaller hand is granulispinulose on its upper and outer surface. In one or two specimens the granules are fewer and more acute, and the lower finger forms a slight angle with the inferior margin of the hand.

This is evidently a very common and abundant species in the Corean seas. Specimens were collected at seven different localities in or near the Corean Straits, at depths varying from 12-40 fathoms. It was, however, previously unrepresented in the British-Museum collection.

I should have regarded this species as being synonymous with the *Pilumnus minutus* of De Haan (Faun. Jap., Crust. p. 50, pl. iii. fig. 2), which is very shortly characterized, were it not that the antero-lateral margins are described and figured as "4-dentatis" (not spinose), and the orbits as "inermibus" by De Haan.

Stimpson's specimens of *P. hirsutus* were collected in the North-China sea and near Ousima Island.

PILUMNUS DEHAANII, sp. n.

The carapace is broader than long, convex, and everywhere covered with a close velvety pubescence, so that no traces of the regions are visible. Antero-lateral margins shorter than the postero-lateral, and armed with three small spines (excluding that of the outer orbital margin, which is not at all prominent). The orbital margins and the front (seen in a dorsal view) are minutely denticulated. In an anterior view the frontal margin is sinuated, with a median notch. The anterior legs are short, robust, the right slightly the larger; the arm trigonous and very short; the wrist with a few conical acute granules on its anterior and upper surface; the palm smooth on its inner, and armed on its upper and all its outer surface with numerous, crowded, unequal, conical, acute tubercles; fingers acute, meeting when closed, the upper granulous at base. The ambulatory legs are slightly compressed and hairy. Length $3\frac{1}{2}$ lines, breadth $4\frac{1}{4}$ lines.

The single specimen, a female, was found within the shell of a species of *Balanus* collected in the Gulf of Yedo.

This species, on account of the closely pubescent carapace and form of the hands, has more of the aspect of an *Actumnus* than of *Pilumnus*, but differs in the acute fingers and spiniform antero-lateral teeth from that genus.

I cannot refer it to any of the numerous published descriptions. It is readily distinguished by the nearly equal and closely tuberculated hands, the tubercles extending halfway along the mobile finger and covering the outer surface of the hand to the apex of the immobile finger. The fingers are nearly colourless. From the *P. actumnoides* of M. A. Milne-Edwards from New Caledonia (Nouv. Arch. Mus. H. N. ix. p. 247, pl. x. fig. 3, 1873), to which it bears some resemblance, it is at once distinguished by the fewer lateral marginal teeth, &c.

It has also some affinity with the *Pilumnus setiger* and *P. squamosus* of De Haan, which have been referred by M. A. Milne-Edwards, rightly I believe, to *Actumnus*. From the former it differs in the regions of the carapace being obliterated, and from the latter in the conical (not squamiform) tubercles of the hands, which are not seriatly disposed; from both, probably, in the spiniform marginal teeth.

PORTUNIDÆ.

THALAMITA SIMA.

Thalamita sima, Milne-Edw. Hist. Nat. Crust. i. p. 460 (1834); Stimpson, Proc. Ac. Nat. Sci. Phil. p. 39 (1858); A. M.-Edw. Arch. Mus. Hist. Nat. x. p. 359 (1861).

Portunus (Thalamita) arcuatus, De Haan, Faun. Japon., Crust. pp. 10, 43, pl. ii. fig. 2, pl. xiii. fig. 1 (1835).

A female example was collected of this species, which seems to

be commonly distributed along the Asiatic coasts from the Red Sea to Japan, and is also found on the coasts of Australia and New Zealand.

Uku Sima ; lat. $33^{\circ} 15\frac{1}{2}'$ N., long. $129^{\circ} 5'$ E.

GONIOSOMA ORNATUM.

Portunus (Thalamita) truncatus, De Haan, Fann. Japon., Crust. pp. 10, 43, pl. ii. fig. 3, & pl. xii. fig. 3 (1835), nec Fabr.

Goniosoma ornatum, A. M.-Edw. Arch. Mus. Hist. Nat. x. p. 376 (1861).

Two specimens (males) were collected—one in Ousima Harbour at 8 fathoms, on a bottom of sandy mud and broken shells, the other in lat. $34^{\circ} 6'$ N., long. $136^{\circ} 15'$ E., at a depth of 11 fathoms.

This species has not, so far as I know, been recorded elsewhere than in the seas of Eastern Asia. Specimens are in the British Museum from the Philippines.

GONIOSOMA VARIEGATUM.

Portunus variegatus, Fabr. Ent. Syst. Suppl. p. 364 (1798).

Cancer callianassa, Herbst, Naturg. Krabben, iii. (2) p. 45, pl. liv. fig. 7 (1801).

Thalamita callianassa, M.-Edw. Hist. Nat. Crust. i. p. 464 (1834).

Charybdis variegatus, De Haan, Faun. Japon., Crust. pp. 10, 42, pl. i. fig. 2 (1835); Stimpson, Proc. Ac. Nat. Sci. Phil. p. 39 (1858).

Goniosoma callianassa, A. M.-Edw. Arch. Mus. Hist. Nat. x. p. 382 (1861).

A single specimen, in which all the legs (except the fifth natatory legs) are wanting, and without definite locality, is in the collection.

It seems evident that the name of *variegatum* should be retained for this species, as Milne-Edwards, who was the first to apply to it Herbst's later name of *callianassa*, considers the *variegatum* as only a marked variety of the same species. There is a specimen from Hong-Kong in the British-Museum collection.

PORTUNUS CORRUGATUS.

Cancer corrugatus, Pennant, Brit. Zool. iv. p. 5, pl. v. fig. 9 (1877).

Portunus corrugatus, Leach, Ed. Encycl. vii. p. 390 (1814), Linn. Trans. xi. p. 315 (1815); Mal. Pod. Brit. pl. vii. figs. 1, 2 (1825); M.-Edw. Hist. Nat. Crust. i. p. 443 (1834); De Haan, Faun. Japon., Crust. p. 40 (1835); Bell, Brit. Crust. p. 94 (1853); A. M.-Edw. Arch. Mus. Hist. Nat. x. p. 401, pl. xxxvi. fig. 3 (1861); Heller, Crust. südl. Europa, p. 86 (1863).

Portunus strigilis, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 38 (1858); A. M.-Edw. Arch. Mus. Hist. Nat. x. p. 402 (1861).

Three specimens, of small size (two males and a female), of *Portunus* are in the collection, which agree in every respect with ex-

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amples of the common *P. corrugatus* of the European seas. The strigose and hairy carapace, and the form of the frontal lobes, of the teeth of the antero-lateral margins, of the anterior and ambulatory legs, of the male postabdomen, and intromittent organs, are identical in the Japanese specimens and examples of the same size from the Mediterranean. It cannot be doubted that this is also the species described by Stimpson under the name of *P. strigilis*, and of which M. Alphonse Milne-Edwards, when he published his monograph of the *Portunidae*, had not seen examples.

Goto Island Ojica, at low-water mark; same locality, lat. $33^{\circ} 12\frac{1}{2}'$ N., long. $129^{\circ} 5'$ E., at 9 fathoms; also at lat. $32^{\circ} 49'$ N., long. $128^{\circ} 54'$ E., at 11 fathoms.

I am inclined to regard the species described as *P. subcorrugatus* by A. Milne-Edwards (A. Mus. H. N. x. p. 402, pl. xxxvi. fig. 2), from the Red Sea, as a mere variety of this species, from which it differs only in the obscure trilobation of the front. There is an example from Naples in the British-Museum collection. Its distribution, therefore, so far coincides with that of the typical *P. corrugatus* that it is found both in the European and Oriental regions—that is, on either side of the Isthmus of Suez.

CORYSTIDÆ.

TRICHOCAECINUS.

Trichocera, De Haan, Faun. Japon., Crust. p. 16 (1833).

The genus *Trichocera*, founded by De Haan, appears to be scarcely generically distinct from *Cancer*, its chief characteristics (and those wherein it exhibits a degradation from the Cancroid type) consisting in its narrower, more convex carapace and longer antennules, on which account it has been placed by Dana and other authors in the *Corystidæ*. It is necessary, if it be retained, to alter its designation, as the name *Trichocera* had been previously employed (in 1803) for a genus of Dipterous insects.

I have therefore slightly modified the termination of De Haan's name, and propose *Trichocarcinus* for the few species of this group, which includes, besides the two now described, only the *Trichocarcinus gibbosulus* (De Haan) and *Trichocarcinus oregonensis* (Dana).

TRICHOCAECINUS DENTATUS, sp. n.

Carapace smooth, minutely granulated, with the gastric, cardiac, and the middle of the branchial regions convex; there are two somewhat higher elevations on the gastric and each branchial region. Front five-toothed, the middle one very small, the two outer separated from the rest by a wide interval. Antero-lateral margins with nine, flat, subequal teeth, which are in contact with one another at their bases and broadly triangulate at their apices, and with their margins granulated; behind the ninth tooth is usually a small tooth on the postero-lateral margin, which is defined by a line of granules. The anterior legs are rather robust; there are three spines on the wrist, on the inner and outer surface, and upper mar-

gin near the distal extremity. Hand with usually two spines on its upper margin, and three longitudinal raised lines on its outer surface.

Length of largest male $10\frac{1}{2}$ lines, breadth 1 inch; of largest female, length 1 inch 1 line, breadth $1\frac{1}{2}$ inch.

Specimens were collected off the Corean coast, in lat. $34^{\circ} 30' N.$, long. $125^{\circ} 20' E.$, at 37 fathoms; in lat. $33^{\circ} 19' N.$, long. $129^{\circ} 12' E.$, in 36 fathoms; in lat. $33^{\circ} 21' N.$, long. $128^{\circ} 48\frac{1}{2}' E.$, at 22 fathoms; and at Otarranai, lat. $43^{\circ} 12' N.$, long. $141^{\circ} 1' E.$, at $5\frac{1}{2}$ fathoms, on a bottom of coarse sand.

In the females the gastric and branchial regions are very much more convex than in the males.

There is considerable variation in the sculpture of the wrist and hands. In some specimens the wrist is roughly ridged on its outer surface; in others it is nearly smooth. The spine on the middle of the upper margin of the hand is sometimes obsolete.

This species differs both from the *T. gibbosulus*, De Haan, from Japan, and the *T. oregonensis*, Dana, from Puget Sound, in the much broader subequal teeth of the antero-lateral margin, in which it has more resemblance to some species of *Cancer*, e. g. *C. edwardsii*, Bell; but it cannot be confounded with that or any other of the genus known to me.

TRICHOCAECINUS AFFINIS, sp. n.

Carapace everywhere granulated and sparsely pubescent, with the middle of the gastric and of the cardiac region convex, and a tubercular prominence on each side of the gastric, one smaller on the hepatic, and three on each branchial region. Front three-toothed. Antero-lateral margins with nine, alternately larger and smaller, acute triangular teeth (including the outer orbital tooth); the margins of these teeth are seen under a lens to be minutely denticulated; there is a smaller tooth on the postero-lateral margin behind the last tooth of the antero-lateral margins. Wrist and hand with three series of spinules on the outer surface; wrist with a strong spine, and hand with two spinules on its upper margin. Ambulatory legs pubescent. Length of female $\frac{5}{12}$ inch, breadth rather more than $\frac{1}{2}$ inch.

A male was collected at a depth of 50 fathoms, in lat. $33^{\circ} 19' N.$, long. $129^{\circ} 7\frac{1}{2}' E.$; and there is a female individual without definite locality also in the collection.

The species is allied to *T. gibbosulus*, De Haan (Faun. Japon., Crust. p. 45, pl. ii. fig. 4, and pl. xiii. fig. 3), which it resembles in the unequal teeth of the antero-lateral margins; but it differs in the much stronger tuberculation of the carapace, and in having only two spines on the upper margin of the hand.

A larger series might show it to be the young of *T. gibbosulus*; but the two specimens before me differ very much from De Haan's figure of that species.

TELMESSUS.

Telmessus, White, Ann. & Mag. Nat. Hist. (ser. 1) xvii. p. 497 (1846).

Platycorystes, Brandt, Bull. Phys. Math. Acad. Pétersb. vii. p. 179 (1849).

Cheiragonus, Stimpson, Boston Journ. Nat. Hist. vi. p. 465 (1857).

The term *Cheiragonus* appears to have been adopted for this genus on insufficient grounds; it is referred to by Latreille, without description, simply as follows:—"g. *Cheiragone* (Mém. de l'Acad. de St. Pétersb. 1812)," (see Fam. Nat. Règne Anim. p. 270, 1825). On referring to Tilesius' specific description in (Mém. Acad. Pétersb. v. p. 347, pl. vii. fig. 1, 1815), we find it headed *Cheiragonus*, the description commencing with the words *Cancer cheiragonus*. It seems evident to me that Tilesius intended the term *Cheiragonus* as a specific name for the Kamtchatkan species, which must be designated *Telmessus cheiragonus*, as White's generic name *Telmessus* comes next in priority and is accompanied by a description.

TELMESSUS ACUTIDENS.

Cheiragonus acutidens, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 40 (1858).

Japan, Kunashir, lat. $43^{\circ} 34' N.$, long. $145^{\circ} 20' E.$, at 11 fathoms, on a bottom of small stones, three specimens, and N.E. of Yedo Island, in lat. $44^{\circ} 27' N.$, long. $14^{\circ} 22' E.$, one specimen.

This species is separated from the *Telmessus serratus* of the western American coast by a very slight character, the somewhat longer and slenderer teeth of the lateral margins, particularly the third tooth; yet the distinction is constant as far as the series before me serves to prove. Two of the specimens are prettily speckled with brownish red, the spots being visible beneath the close pubescence of the carapace. The carapace of the largest of the four specimens only measures $\frac{3}{4}$ inch in length; and the form of the teeth might undergo some modification as the animal increases in size.

It was previously unrepresented in the British-Museum collection.

Tilesius' species, *Telmessus cheiragonus* from Kamtchatka, is described and figured as having much longer and slenderer marginal spines than even *T. acutidens*; and in the absence of specimens for comparison, I cannot unite the two species.

CATOMETOPA vel GRAPSOIDEA.

MACROPHTHALMIDÆ.

GELASIMUS LACTEUS.

Ocypode (Gelasimus) lactea, De Haan, Faun. Japon., Crust. pp. 26, 54, pl. xv. fig. 5 (1835); M.-Edw.?, Ann. Sci. Nat. (sér. 3), Zool. xviii. p. 150, pl. iv. fig. 16 (1852).

Four specimens (males) are in the collection, without any particulars regarding the locality at which they were collected.

This species is distinguished by the form of the front, which at base is about one fourth the width of the carapace, with the sides slightly converging to the distal extremity, the margin of which is nearly straight. The oblique ridge on the inner surface of the larger hand is distinctly granulated; the fingers are not sulcated externally; and their inner margins are simply granulated without teeth or lobes in the adult. In younger individuals there is a very small tubercle or granule in the middle of the inferior margins. It is probable that the species figured by Milne-Edwards under the name of *G. lacteus* (*l. c.*) is to be referred to a distinct species, as the lower finger has a distinct subterminal tooth. This species has been hitherto unrepresented in the national collection, as the specimen purchased by the Trustees as from the Leyden Museum under this name, and referred to by White (List Crust. Brit. Mus. p. 36, 1847), belongs to Milne-Edwards's first section of the genus, and is identical with the *G. forcipatus* of Adams and White.

GRAPSIDÆ.

HETEROGRAPSUS LONGITARSIS, sp. n. (Plate II. fig. 3.)

Carapace nearly as long as broad, quadrate, the surface somewhat uneven and sparsely hairy; the frontal margin straight, without a median sinus; the postfrontal lobes distinctly marked, the lateral margins straight, not arcuated anteriorly as in most species of the genus, and with three prominent acute teeth. The outer maxillipeds have the third joint not dilated at its antero-external angle, and the exognath narrow as in other species of the genus. The anterior legs are clothed with short pubescence, not robust; wrist with a small spine on its inner margin; hand with a longitudinal raised line on its outer surface, and with a patch of hair on its inner surface in the males; fingers straight. Ambulatory legs slender, compressed, with short close hair disposed in longitudinal series; the tarsal joints of all the legs long and slender. Postabdomen of male nearly as in *H. penicillatus*. Length and breadth about $\frac{1}{2}$ inch.

Otarranai, lat. $43^{\circ} 12' N.$, long. $141^{\circ} 1' E.$, at $5\frac{1}{2}$ fathoms, bottom coarse sand (three males and a female); Yokoska Dock, in Gulf of Yedo, one young individual taken from the ship's bottom; and in lat. $33^{\circ} 12\frac{1}{2}' N.$, long. $129^{\circ} 5' E.$, at 9 fathoms, one young male.

This species is at once distinguished from the Japanese *H. sanguineus* and *H. penicillatus*, De Haan, and most species of the genus, by the narrower hairy carapace with straight sides, and the slender elongated tarsal joints of the fifth ambulatory legs; in these characters it approaches the genus *Cyrtograpsus*, in which genus, however, the outer maxillipeds leave a wider hiatus when closed, and the lateral margins of the carapace are 4-dentated.

PLATYGRAPSUS DEPRESSUS, junior?

Platynotus depressus, De Haan, Faun. Japon., Crust. pp. 37, 63, pl. viii. fig. 2 (1835); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 199 (1853).

Platygrapsus depressus, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 104 (1858).

Two small specimens (male and female) are in the collection. These differ from the description and figure of De Haan, and from an adult male of *P. depressus* in the British-Museum collection, in the existence of a small spine on the wrist at the antero-internal angle; and the posterior tooth of the lateral margins of the carapace is obsolete in one, and very obscurely indicated in the other specimen. The hands are slenderer, and the fingers straight and regularly denticulated on their inner margins, whereas in the adult male the fingers are arcuate and the upper has on its inner margin near the base a large and prominent tooth.

Matoya, $6\frac{1}{2}$ fathoms; lat. $34^{\circ} 13' N.$, long. $136^{\circ} 73' E.$, 48 fathoms.

This species is a common inhabitant of the Chinese and Japanese seas.

The generic name instituted by De Haan, *Platynotus*, having been previously employed, was changed by Stimpson to *Platygrapsus*. A second species, *P. convexiusculus*, described by Stimpson from the Loo-Choo Islands, is scarcely sufficiently distinguished by the characters given.

The genus *Platygrapsus* is distinguishable from *Heterograpsus* and other allied genera, with which it has affinities and which are represented in the Japanese seas, by the form of the second and third joints of the outer maxillipeds, which are *obliquely* articulated with one another, whereas in those genera the margins along which the articulation takes place are *at right angles* with the lateral margins of the joints.

HELICE TRIDENS.

Ocypode (Helice) tridens, De Haan, Faun. Japon., Crust. pp. 28, 57, pl. xi. fig. 2, and pl. xv. fig. 6 (1835).

Helice tridens, M.-Edw. Ann. Sci. Nat. (sér. 3), Zool. xx. p. 189 (1853); Stimpson, Proc. Ac. Nat. Sci. Phil. p. 105 (1858).

E. Japan, Yamada, lat. $39^{\circ} 32' N.$, long. $141^{\circ} 53' E.$, at depth of 7 fathoms; bottom sandy, with broken shells.

A single specimen, an adult female, in the collection. Length 1 inch, breadth nearly 1 inch 4 lines.

This fine species was previously unrepresented in the British-Museum collection.

LEIOLOPHUS PLANISSIMUS.

Cancer planissimus, Herbst, Naturg. Krabben u. Krebse, iii. pl. lix. fig. 3 (1804),

Plagusia clavimana, Desm. Consid. Crust. p. 127, pl. xiv. fig. 2 (1825); M.-Edw. Hist. Nat. Crust. ii. p. 92 (1837).

Acanthopus planissimus, De Haan, Faun. Japon., Crust. p. 30 (1835).

Leiolophus planissimus, Miers, Cat. New-Zeal. Crust. p. 46 (1876); Ann. & Mag. Nat. Hist. (ser. 4) i. p. 153 (1878)

Four examples, a male and three females, without definite locality, are in the collection.

This species is very widely distributed, occurring both in the Indo-Pacific and Atlantic Regions.

CARCINOPLACIDÆ.

HETEROPLAX? NITIDUS, sp. n. (Plate II. fig. 2.)

Carapace smooth, glabrous and shining, subtrapezoidal, transverse, its greatest breadth being at the level of the second lateral marginal tooth; in front of this the carapace and frontal region is obliquely deflexed; behind it the carapace is nearly flat, and the lateral margins straight and slightly convergent to the straight posterior margin. Lateral margins with two small teeth, including the outer orbital tooth. Front about one third the breadth of the anterior margin of the carapace, with the anterior margin straight. Eyes about equalling the front. Antennæ with the first joint about twice as long as the second, which is small, occupying the hiatus between the inner angle of the orbit and the frontal margin. Outer maxillipeds with the third joint quadrate, and about half as long as the second joint, which is smooth and longitudinally sulcated on its outer surface; exognath robust.

Anterior legs (in the female) rather robust; arm very short, smooth; wrist smooth externally, and with a small tubercle on its inner surface; hand smooth, without tubercles or granules; fingers straight and acute, crossing at the tips when closed. Postabdomen of female 7-jointed. Length 3 lines, breadth rather over 4 lines. Colour whitish; brownish pink on front of carapace.

A single specimen, a female, was collected at a depth of 40 fathoms in the Corean Straits, lat. $33^{\circ} 40' N.$, long. $182^{\circ} 55' E.$

I have some doubt whether this species should be referred to the genus *Heteroplax*, which is only known to me by Stimpson's diagnosis, according to which the basal antennal joint is longer and occupies the orbital hiatus. The species in other respects appears referable to the genus. The longitudinal ridges on the palate are distinct. In this character and in the broader front and shorter eye-peduncles it differs from *Gonoplax*, while *Litocheira* of Kinahan, another allied form, has, on the contrary, much shorter eyes and broader and less deflexed front than the species here described. Specimens of the species *L. bispinosa*, on which the last-mentioned genus was founded, are in the British-Museum collection from Australia; and in these the longitudinal palatal ridges are distinctly marked. Kinahan, however, in his description says that they do not exist.

RHIZOPIDÆ.

TYPHLOCARCINUS VILLOSUS.

Typhlocarcinus villosus, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 96 (1858).

A very small male individual is in the collection, without definite locality, which I refer to this species. The carapace and legs are clothed with a dense, short, whitish pubescence, with longer hairs on the margins, near which the scattered granules, which are elsewhere probably concealed by the hairy coat, are visible. The hands are covered with minute subseriate acute granules. The antero-lateral marginal teeth are very small, and can only be seen by removing the hairs. Length $2\frac{1}{2}$, breadth 3 lines.

The specimen agrees with one (a female of larger size) from the Chinese seas, in the British Museum, presented by the Smithsonian Institution.

OXYSTOMATA vel LEUCOSIIDÆ.

LEUCOSIIDÆ.

LEUCOSIA HÆMATOSTICTA, junior?

Leucosia hæmatosticta, Ad. and White, Zool. Samarang, Crust. p. 54, pl. xii. fig. 2 (1848); Bell, Trans. Linn. Soc. xxi. p. 289 (1855); Cat. Leucos. Brit. Mus. p. 8 (1855)

Two specimens were collected, in which the beautiful coloration is very well preserved, and which differ from the typical specimens in the British-Museum collection and White's figure as follows:—The blood-red spots on the carapace and legs are more numerous and smaller, the tubercles on the arms proportionally smaller but similarly disposed, the postabdomen of the male with the sides nearly straight and the second joint not constricted, whereas in the typical *L. hæmatosticta* the second joint is broad at base and greatly narrowed near the distal extremity (see figure quoted). Length of male $4\frac{1}{2}$ lines.

Lat. $33^{\circ} 10' N.$, long. $129^{\circ} 12' E.$, at a depth of 36 fathoms. June, 1876. One male. A female is in the collection without definite locality.

The differences mentioned, although at first sight sufficiently marked, are probably due to the difference in age of the specimens, which agree in the form of the carapace, front, thoracic sinus, and legs. The male individual obtained by Mr. Adams measures rather more than $\frac{1}{2}$ inch ($6\frac{1}{2}$ lines).

PSEUDOPHILYRA, gen. nov.

Allied to and intermediate between *Leucosia* and *Philyra*, but differing from the former genus by the absence of the pit or cavity in the subhepatic region which Prof. Bell has called the *thoracic sinus*, and from *Philyra* in the prominent tridentate front and slenderer straighter exognath of the outer maxillipeds.

So far as I am aware, this genus includes only the following species, *Pseudophilyra tridentata* and *Pseudophilyra perryi*, described by

me in 1877 as *Leucosia perryi*, and which is distinguished from *P. tridentata* by the smooth and polished carapace, which is defined by a *continuous* marginal beaded line. (See Trans. Linn. Soc., Zool. i. p. 238, pl. xxxviii. figs. 19-21, 1877.)

The genus *Leucisca* of MacLeay (Annulosa in Smith's Zool. S. Africa, p. 70, 1838), which resembles *Leucosia*, and in which no mention is made of the existence of a *thoracic sinus*, differs from *Pseudophilyra* and *Leucosia* in having the exognath of the outer maxillipeds robust and curved, and the eyes placed on either side at the base of the front, not at the antero-external angles.

PSEUDOPHILYRA TRIDENTATA, sp. n. (Plate II. fig. 4.)

Carapace (with front) longer than broad, very coarsely punctulated except on the frontal region, where the punctulations are very fine. Frontal margin tridentate, the front itself narrowed and much produced, as in the genus *Leucosia*. There is a distinct elevation on the hepatic region, and immediately in front of it a marked depression. A minutely beaded line defines the posterior and posterolateral margins of the carapace, becoming obsolete on the anterolateral margin. The inferior surface of the body is smooth; the exognath of the outer maxillipeds is rather broad, but its outer margin nearly straight, not arcuated as usual in *Philyra*. The postabdomen of the male has all the joints except the last coalescent, but the sutures are not entirely obliterated. Colour light brownish-pink. Length $4\frac{1}{2}$, breadth 4 lines.

One specimen, a male, was collected in lat. $33^{\circ} 4' N.$, long. $129^{\circ} 18' E.$, in 23 fms.

In this specimen the legs are unfortunately wanting; an anterior leg that was in the same phial, and probably belongs to the specimen, has the arm very finely tuberculated, wrist and hand smooth, fingers slightly gaping at base when closed.

PHILYRA, sp.

Several specimens (males and females) of a species of *Philyra*, on account of their small size (their length is only about 3 lines), I do not designate by a distinct specific name, as they may not be fully matured. They resemble *Ph. platycheira*, De Haan, in the form of the carapace, which is nearly smooth and marked with a distinct depression between the cardiac and branchial regions, in the very finely granulated arms, &c. The anterior legs, however, are much shorter than in that species, the palm shorter and more swollen, and the fingers less compressed. The pterygostomial region is not angulated, and the intestinal region rather convex. From the *P. pisum* described by De Haan this species differs in the non-angulated pterygostomial region, from the *P. tuberculosa*, Stimpson, from Hong-Kong, in the non-tuberculated carapace, and from the *P. unidentata*, Stimpson, from the China Sea, in the form of the front. It may not improbably be a distinct species from any hitherto described.

Collected at Matoya, in $6\frac{1}{2}$ fms.

The colour is light yellowish brown, flecked with spots of darker brown, of which two are rather prominent and situated one on each branchial region.

MYRA.

The species of this genus, all of which occur in the seas of Eastern Asia, bear a very close resemblance to one another; and the form and tuberculation of the carapace and anterior legs not improbably alter considerably as the animal increases in age. On this account it is not without much hesitation that I regard the specimens described below as belonging to a distinct and undescribed form, as they are all of small size; but they cannot, in the present state of our knowledge, be referred to any of the known species.

MYRA DUBIA, sp. n.

Carapace convex, rhomboid-oval, longer than broad, and covered with minute distant granules; there is a faintly but distinctly marked longitudinal median raised line. The median spine or tubercle is but little longer than the lateral ones, conical and acute; and a short distance in front of it, on the front of the intestinal region, is another very small but distinct tubercle. Front and hepatic regions as in *Myra carinata*. Anterior legs about twice as long as the body, slender; arm distinctly and hand finely granulated; fingers straight and acute. Postabdomen of the male elongate-triangular, with the sides nearly straight; surface smooth and flat; all the joints except the last coalescent. Length $6\frac{1}{2}$ lines, breadth $5\frac{1}{2}$ lines.

Three specimens, males, are in the collection, without definite locality.

The nearest ally of this species is evidently the *Myra carinata* of Bell from the Philippines, from which it differs in the broader carapace with shorter median posterior spine. Moreover it differs from this and all the other species of the genus in the existence of the small tubercle in front of the posterior spine. There is, however, in the British-Museum collection a male individual from Hong-Kong, of much larger size, which *may* be identical with the Japanese species, in which the tubercle does not exist. From *Myra fugax*, *affinis*, *elegans*, and *mamillaris* it differs in the form of the tubercles of the posterior margin and postabdomen of the male.

EBALIA RHOMBOIDALIS, sp. n.

Carapace rhomboidal, rather broader than long, uniformly and finely granulated; cardiac and intestinal regions convex but not tuberculated. Frontal margin straight. Antero-lateral margins straight and not interrupted, forming nearly a right angle with the postero-lateral margins, which are nearly straight; posterior margin, behind the intestinal prominence, obscurely bilobated. A moderately prominent longitudinal median ridge joins the front and the intestinal prominence with the elevated cardiac region; and from the cardiac and intestinal regions transverse ridges reach to the postero-lateral margins. There is no tubercle on the pterygostomian

region. Anterior legs rather long and nearly smooth; arm obscurely trigonous, but without prominent angles; palm moderately convex; fingers straight and acute. Postabdomen of male with all the segments except the last coalescent. Length $5\frac{1}{2}$ lines, breadth 6 lines.

A male and female are in the collection, without definite locality.

This species differs from most of the genus in the entire absence of tubercles upon the carapace. It has some affinity with *Ebalia tuberosa*, Pennant (*E. pennantii*, Leach), from the British seas, but differs in the uninterrupted lateral margins and in the form of the front, which in that species is concave.

EBALIA MINOR, sp. n.

This species resembles the preceding; but the carapace is broader and very much more coarsely granulated on the frontal, cardiac, branchial, and intestinal regions and antero-lateral and postero-lateral margins. The front is slightly concave. The intestinal region is much less prominent, and there is scarcely any trace of longitudinal and transverse ridges; the posterior and postero-lateral margin of the carapace is slightly revolute. Length 3 lines, breadth $3\frac{1}{2}$ lines.

Three males and one female were collected with the preceding; and all are of much smaller size than the fully-grown male of the preceding species, to which they bear much external resemblance. The distinctions, however, are not sexual, and appear too considerable for the two forms to be varieties of one and the same species.

EBALIA BITUBERCULATA, sp. n.

This species resembles the *E. rhomboidalis*; but the longitudinal and transverse ridges on the carapace and the depressions on the branchial region are much more strongly marked; in the centre of the carapace, upon the branchial region, are two distinct tubercles; the posterior margin is broader and straight, not bilobed.

A single female example was obtained at 52 fms., in lat. $34^{\circ} 12' N.$, long. $136^{\circ} 28' E.$

CRYPTOCNEMUS PENTAGONUS. (Plate II. fig. 5.)

Cryptocnemus pentagonus, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 161 (1858).

A single male individual is in the collection, obtained at 36 fms., in lat. $33^{\circ} 10' N.$, long. $129^{\circ} 12' E.$, in June 1876. It has unfortunately lost all its legs, but agrees in all respects with Stimpson's description.

This is a most interesting addition to the British-Museum collection, as only three species have been described, the present being the only one not figured hitherto, and that on which the genus was founded. A comparison of the figure now given with that of the *C. holdsworthi* described by me last year in Trans. Linn. Soc. (ser. 2), Zool. i. p. 241, pl. xxxviii. figs. 30-32, will show the differences in the form of the carapace and rostrum between the two species.

ARCANIA GLOBATA.

Arcania globata, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 160 (1858).

A single specimen, male, was collected in 24 fms., in lat. $34^{\circ} 8' N.$, long. $126^{\circ} 24' E.$

The legs are unfortunately wanting; but the form and armature of the carapace and rostrum agree exactly with Stimpson's description. Its nearest allies are apparently the *Arcania tuberculata* of Bell (Trans. Linn. Soc. xxi. p. 310, pl. xxxiv. fig. 8, 1855)—from which it differs in the longer, more acute, and equal spines on the surface of the body,—and the *Arcania erinacea* of Fabricius, which has the legs spinulose and the front much more deeply incised. There is a second specimen, from the "Eastern Seas," in the British-Museum collection.

I take this opportunity of noting that the *Arcania granulosa* described by me (Trans. Linn. Soc. ser. 2, Zool. i. p. 240, pl. xxxviii. fig. 29, 1877) must probably be united with the *Arcania 11-spinosa* of De Haan, Faun. Japon., Crust. p. 135, pl. xxxiii. fig. 8 (1841), the characters given not being sufficient to distinguish it from that species.

ARCANIA ORIENTALIS, sp. n.

Carapace subglobose, compressed, with the front somewhat produced, and with two depressions, well defined posteriorly, separating the cardiac and branchial regions; the whole of the upper surface covered with small closely-placed granules. Cardiac and intestinal regions very high and convex. Front slightly bilobed, with a median sulcus between the eyes; lateral margins of the carapace without spines; posterior margin straight, and forming on each side a prominent but rounded angle with the postero-lateral margins. Anterior legs rather slender, with the arm very finely granulated; wrist and hand nearly smooth. Postabdomen of the male narrow-triangular, with all the joints except the first and last coalescent; the coalesced portion is marked with a longitudinal median sulcus, a prominence on each side at base, and a prominent acute tubercle at the distal extremity, the terminal joint is narrow and elongated. Length and breadth about 3 lines.

Two individuals, males, are in the collection:—one obtained in lat. $33^{\circ} 10' N.$, long. $129^{\circ} 12' E.$, at 36 fms.; the other at 30 fms., in lat. $34^{\circ} 10' N.$, and long. $136^{\circ} 47' E.$

This species is distinguished from its congeners by the evenly granulated carapace, which is quite destitute of spines. The granules in one specimen preserve some faint traces of a red coloration.

ANOMURA¹.

DROMIDEA.

DROMIIDÆ.

CRYPTODROMIA, sp.

A very small specimen, obtained at 30 fathoms, in lat. $34^{\circ} 10' N.$, long. $136^{\circ} 47' E.$, is in the collection.

¹ For convenience's sake, Dana's arrangement and nomenclature of the groups of *Anomura* is followed.

The frontal portion of the carapace is triangular, deflexed, concave above, with five obscure marginal teeth (including the supraocular and median frontal teeth). Carapace convex, sparsely pubescent, without any indication of the different regions; antero-lateral margin with three small teeth. The anterior legs are small, weak, pubescent, and smooth. The second and third legs are compressed, pubescent, and with a tubercle at the distal extremity of the penultimate and antepenultimate joints. This individual may be the young of *C. tumida*, Stimpson, from the island of Ousima; it would not in any case be desirable to constitute it the type of a new species. Length barely 3 lines. The specimen is a young male.

HOMOLIDÆ?

PARATYMOLUS.

The carapace is shaped nearly as in *Homola*, e. g. with the front and postfrontal region deflexed, behind the hepatic region flat, with the sides nearly straight. The front is prominent and narrow, composed of two coalescent spines. The antennules are small and apparently broken in the single specimen collected. The antennæ are elongated, the joints of the peduncle hairy, the flagella very slender. The eyes are slender, of normal shape, the peduncles cylindrical and laterally projecting, not, as in *Homola*, divided into two portions. The outer maxillipeds are rather slender, the second about twice as long as the third joint, the exognath slender and not prolonged beyond the end of the third joint. The anterior legs in the female very slender, fingers longer than the slender palm; the ambulatory legs all alike in form, slender, smooth, the tarsal joints long, straight, and unarmed, those of the fifth pair not raised upon the dorsal surface of the cephalothorax. Postabdomen (of female) jointed, ovate.

The systematic position of this genus is somewhat uncertain, as the specimen, which is unique and very small, cannot be dissected with safety. Stimpson placed his genus *Tymolus* among the *Dorippidæ*; but the outer maxillipeds of *Paratymolus* are more of the Maioid than of the Leucosiid type; and on account of its general resemblance to *Homola* I place it, at least provisionally, with that genus among the Anomura Maiidica. Although the legs are not dorsally raised upon the cephalothorax, it evinces a certain degradation from the Brachyural type in the absence of defined orbits, the long antennæ, and several other points; but it may hereafter be thought better to place it among the Maioid Brachyura. The outer maxillipeds are less pediform than in *Homola*, but less distinctly operculiform than in the generality of Maioid Crustaceans.

PARATYMOLUS PUBESCENS, sp. n. (Plate II. fig. 6.)

Carapace and legs everywhere covered with a close velvety pubescence; a strong spine at the angle of the hepatic region, and another smaller in front of it, two small tubercles in front of the gastric and one on the cardiac region, and two in the middle of the

postero-lateral margin. Arms smooth; wrist with a long spine on its inner margin. The slender terminal joints of the legs are longer than the preceding joints. Length of carapace and rostrum barely 3 lines.

A single female example was collected at Matoya, at a depth of $6\frac{1}{2}$ fms.

This specimen is of very small size; but in the form of the fifth ambulatory legs it appears to be generically distinct, both from *Homola* and *Tymolus*, an allied genus from the Japanese seas, described by Stimpson; from the former genus it is further distinguished by the form of the eyes, and from the latter by that of the front, which is not quadridentate.

RANINIDEA.

RANINA SERRATA.

Cancer raninus, Linn. Syst. Nat. (ed. xii.), p. 1039 (1766).

Ranina serrata, Lam. Syst. An. sans Vert. p. 256 (1801); M.-Edw. Crust. in Cuvier, Règne Animal (ed 3), Atlas, pl. xli; Dana, U.S. Expl. Exp. xiii. Crust. i. p. 404 (1852).

Ranina dentata, Latr. Encycl. Méth. p. 268 (1825); M.-Edw. Hist. Nat. Crust. ii. p. 194, pl. xxi. figs. 1-4 (1837); De Haan, Faun. Japon., Crust. p. 139, pl. xxxiv. ♂ adult, pl. xxxv. fig. 1, ♀ adult, figs. 2 & 3, front of ♂, fig. 4, front of ♀ (1841).

A single individual, a male, was collected in Olvasi, Nipon, of moderate size, of this well-known species, which appears to be widely distributed through the Indo-Pacific region.

LYREIDEUS TRIDENTATUS?

Lyreideus tridentatus, De Haan, Faun. Japon., Crust. p. 140, pl. v. fig. 6 (1849).

A single specimen in imperfect condition was collected in Kada Bay, which I refer to De Haan's species with some doubt, as it differs in several particulars from the figure in the 'Fauna Japonica,' and the figures illustrating this work are, as a rule, most accurate. The carapace in the specimen before me is proportionally narrower, barely equalling in width half the total length. The greatest width at the lateral spines is attained at a greater distance from the front than in the specimen figured by De Haan; the median triangular lobe of the front is narrower; and there are four spines on the inferior margin of the hand.

If the species should prove upon comparison to be distinct, it may be designated *L. elongatus*. It in any case forms an interesting and valuable addition to the national collection, in which the genus was hitherto unrepresented; nor does it appear that any specimens were collected in the United States Expedition to the North Pacific, as none are mentioned in Stimpson's Report.

PORCELLANIDEA.

PORCELLANA SPINULIFRONS, sp. n.

Two small specimens are in the collection, the exact locality [30]

whence they were obtained not being stated. They differ from the description of *P. latifrons* Stimpson (Proc. Ac. Nat. Sci. Phil. p. 243, 1858), only in the following particulars. There are only two spines on the lateral margins of the carapace in front of the branchial regions, and one behind the outer orbital spine. The denticulations of the frontal lobes are very minute, but more numerous than in *P. latifrons*—about 9 on the median lobe and 4 on each lateral lobe; there are only two spines on the posterior margin of the carpus.

It is possible that a larger series would show these differences are not of specific importance.

PACHYCHELES STEVENSII.

Pachycheles stevensii, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 242 (1858).

Two specimens are in the collection, without definite locality (male and female). This species was previously unrepresented in the collection of the British Museum. Stimpson's specimens were from the west coast of the island of Jesso, Japan.

With one exception (the *P. natalensis*, Krauss) the only species of this genus, besides the two described by Stimpson, inhabit the American coasts—another indication of the affinity existing between its Crustacean fauna and that of the Japanese seas.

LITHODIDEA.

HAPALOGASTER DENTATUS.

Lomis dentata, De Haan, Faun. Japon., Crust. p. 219, pl. xlviii. fig. 3 (1849).

Hapalogaster dentatus, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 245 (1858).

A single specimen, female, in mutilated condition, was collected at the Goto Islands at low-water mark. It agrees well with a specimen from Simoda, presented to the British Museum by the Smithsonian Institution.

This species belongs to a genus which, having a boreal range, is found on the west coast of the American continent as well as on the shores of Eastern Asia. An allied species, *H. mertensii*, has been described by Brandt from Sitka, and a third, *H. cavicauda*, by Stimpson from California.

CRYPTOLITHODES EXPANSUS, sp. n.

The species which I have thus designated is represented only by a single small specimen in dried condition. The carapace is transversely oval, with the lateral wing-like expansions broadly rounded, the surface everywhere minutely punctulated. The rostrum is scarcely at all deflexed, truncated, and but very obscurely tridentate at its distal end. There is a convexity upon the gastric, and one more prominent upon the cardiac region, on either side of which is a less elevated tubercle, the three forming a transverse series. A longitudinal median ridge extends from the gastric prominence

nearly to the distal end of the rostrum. There are no tubercles on the lateral expansions of the carapace; but the lateral margins are obscurely toothed, as in *C. typicus*. The anterior legs have the palms tuberculated externally; and the ambulatory legs are cristate, as in that species. Length to end of rostrum $4\frac{1}{2}$ lines, breadth 6 lines.

North Japan.

From *Cryptolithodes typicus*, Brandt, from California, this species differs in the less-deflexed rostrum, the absence of tubercles on the lateral lobes of the carapace, and the shape of these expansions, which are broadly rounded, with the lateral margins regularly arcuated, whereas in *C. typicus* the latero-anterior and latero-posterior margins form a more or less distinct angle one with another. It is probable that this character will always suffice to differentiate the species, even if the others should fail in older individuals. *C. sitchensis*, Brandt, from Sitka, has, according to Stimpson, a tridentate rostrum and smooth hands.

C. alta-fissura, Spence Bate, from Vancouver Island, of which there is a specimen in the Museum, is distinguished by the broad, flat, and rectangular rostrum, and the deep notch in the carapace in which the eyes are situated¹.

PAGURIDEA.

EUPAGURUS CAVIMANUS, sp. n. (Plate III. fig. 1.)

Carapace slightly punctulated on the sides in front of the branchial regions, and with a small acute median frontal lobe. Eye-peduncles subcylindrical, scarcely shorter than the peduncles of the antennæ, not constricted in the middle, their basal scales entire, and concave above. Antennules with the peduncles rather longer than the eyes. Antennæ with their slender basal acicles a little shorter than the peduncles. Anterior legs very unequal; larger (right) leg with the arm very short, trigonous, concave on its outer surface, and with a few spinules on its distal upper margin; wrist about as long as broad, and much broadest at its distal extremity, convex and faintly punctulated on its outer surface, its inner surface smooth and concave, and its upper and lower margins distally produced into thin crests, the upper of which is obscurely serrated; hand with the upper and lower margins parallel and sub-cristiform, slightly convex, and nearly smooth on its outer surface, mobile finger not cristate above, and about as long as the upper margin of the palm. Smaller leg very slender, wrist externally granulated and serrated above; palm subovate, smooth, and concave on its outer surface. Legs of second and third pairs slender, nearly smooth, the terminal joints rather longer than the preceding, and with short stiff hairs on their upper and lower margins.

¹ There is also a dried specimen in the Museum, from Vancouver Island, which closely resembles *C. typicus*, but is distinguished by the form of the rostrum, which is obtusely triangular, and does not project beyond the anterior margin of the carapace. This I propose to designate *C. brevifrons*.

One individual was collected at a depth of 100 fathoms, in lat. $41^{\circ} 40' N.$, long. $141^{\circ} 10' E.$

By the form of the ophthalmic scales, the dilated carpus of the right anterior leg, and the externally concave palm of the left anterior leg, this species is easily distinguishable from its congeners.

It does not seem to be allied in any close degree to any of the species described by Stimpson from the Chinese and Japanese seas. In *Eupagurus forceps*, M.-Edw., a Chilian species, which has the wrist of the larger hand strongly cristate above and beneath, the fingers of the smaller hand are described as being very long, slender, and acute, whereas in *E. cavimanus* they are of moderate length.

There are a few other specimens of Paguridea in the collection, which, being in mutilated condition, cannot be determined with certainty. One, obtained at the Goto Islands at low-water mark, has lost the postabdomen and one of the anterior legs, but is perhaps referable to the *Pagurus lanuginosus* of De Haan. Another, which, like *Pomatocheles jeffreysii*, inhabited a shell of *Dentalium*, is too imperfect to be described.

POMATOCHIELES, gen. nov.¹

Cephalothorax and its appendages as in the *Paguridæ*. Carapace with a median frontal lobe, and postfrontal and other sutures; posteriorly it is partly membranaceous. Postabdomen as in the *Macrura*, extended, straight, with parallel sides, composed of seven distinct segments, inferiorly closed by two longitudinally-folding membranaceous flaps, which meet in the middle line. Eye-peduncles slender, cylindrical, straight. Antennules and antennæ rather short, the latter with simple multiarticulate flagella. Antennal aciculum small. Outer maxillipeds subpediform. Anterior legs (as in *Cancel-lus*) equal; hands bent obliquely downwards from the wrists, and flattened above, fingers opening horizontally, and acute at tips. Second and third legs slender, elongated, terminal joints long, straight, and acute. Fourth and fifth legs small and weak; last joint of fourth pair with a small terminal claw, and that of the fifth pair with a tuft of hairs and minute claw at its distal end. Postabdominal appendages of the second to fifth segments slender, those of the second segment elongated, and 4- or 5-jointed, the rest short. Appendages of the penultimate segment (uropoda) with two lamellate unequal rami. Telson membranaceous in its distal half, and divided by a terminal notch into two rounded lobes.

I have much pleasure in dedicating the single species of this remarkable genus to Dr. J. Gwyn Jeffreys, F.R.S., by whom the entire series of Crustacea collected by Capt. St. John was presented to the British Museum.

POMATOCHIELES JEFFREYSII, sp. n. (Plate III. fig. 2.)

The animal is slender and elongated. The carapace is marked

¹ $\pi\omega\mu\sigma$, a lid, and $\chi\eta\lambda\acute{\eta}$, a claw.

with a distinct postfrontal and lateral suture, besides two smaller and less distinct sutures on the sides towards the lateral margins. The median frontal lobe is broadly triangulate and rounded at apex. The first postabdominal segment is very small, the five following subequal, with the lateral margins straight, the last small, transparent, and membranaceous in its distal half, and ciliated on its margins, the terminal median notch very small. The ocular peduncles are a little shorter than the frontal margin, and are furnished with very small scales at base. The corneæ are of a red-brown colour. The antennules are half as long again as the eye-peduncles, the antennæ about as long as the antennules; the aciculum at base very small, acute, not half as long as the eye-peduncles. The anterior legs are much as in *Cancellus*; the arms with a slight denticulated crest on their upper surface, the wrists very short and slightly denticulated above; the flattened upper surface of the palms is covered with thick short hair, the surface beneath being smooth, and the straight inner and arcuate outer margins very slightly denticulated. The slender and elongated legs of the second and third pairs have the antepenultimate joint short, the two following long and straight, the last in particular very long, slender, and acute. The truncated distal end of the last joint of the fourth leg is armed with a series of short stiff setæ or spinules, and a small claw or spine; that of the fifth pair is densely ciliated. The basal portion of the uropoda is short and broad, and bears two unequal lamelliform rami, which are of spongy texture on the outer surface, and ciliated on the margins; the outer is twice as long as the inner. Length 5 lines.

Two specimens were collected, inhabiting a species of *Dentalium*, at a depth of 58 fathoms, in lat. $32^{\circ} 43'$ N., long. $129^{\circ} 28'$ E., preserved in spirit. They were so firmly ensconced in the narrow conical shell that forms their home, that the one from which the foregoing description was mainly taken could not be extracted without breaking the shell. The chelæ of the anterior legs, meeting above the head, and in close contact along their flat inner margins, form a perfect operculum, fitting the aperture of the shell (hence the name of the genus), serving to defend its inhabitant against foreign intruders.

Subsequently two other specimens, in a dry state, were extracted from specimens of *Dentalium*, collected in 48 fathoms, in lat. $34^{\circ} 13'$ N., long. $136^{\circ} 37'$ E. They appear to be males, as the genital apertures are visible at the base of the fifth legs.

This remarkable form is of great interest as apparently establishing a transition from the Paguridea to the Macrura. In the form of the carapace, eyes, antennæ, and cephalothoracic limbs it has so much affinity with *Cancellus*, that, had the rest of the animal been wanting, I should have considered it a species of that genus. But in the narrow, straight, and distinctly-segmented postabdomen, and in the form of its appendages, it far more nearly approaches the Macrura than does *Cancellus*. Perhaps its nearest allies are to be found in the little-known genus *Prophylax* of Latreille¹, and *Glau-*

¹ In Cuv. R. A. (ed. 2), p. 78 (1829).

cothoë of Milne-Edwards¹. The latter, which is placed by Dana in the *Gebiidae*, is only known to me by the figures and descriptions of its author; it presents decided affinities with the *Paguridea* in the form of the fourth and fifth legs of the cephalothorax, eyes, antennæ, and anterior legs, which are more distinctly *Macruran* in type. *Glaucothoë* has been considered by Mr. Spence Bate² to be but the immature condition of *Pagurus*; and he figures and notices a specimen of that or a closely-allied genus that had been taken floating on the surface of the sea. Whether his contention be correct or not (and his remarks and figures do not appear to me to suffice to decide the question), there can, I think, be little doubt that the specimens of *Pomatocheles* I have examined are mature; and the fact that they had been found at considerable depths permanently ensconced within the shell of *Dentalium* seems confirmatory of that opinion. From *Glaucothoë Pomatocheles* is easily distinguished by the form of the chelæ of the anterior legs and of the carapace, not to mention other characters.

GALATHEIDEA.

GALATHEA ORIENTALIS.

Galathea orientalis, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 252 (1858).

A large series of this species was collected, the specimens agreeing in all respects with Stimpson's description, and the number of spines on the gastric region and lateral margins being remarkably constant; only it is to be noted that the large spine on the inner surface of the wrist varies considerably in size, sometimes not being much larger than the other spinules of the anterior legs; there is usually a small tooth on the inner margin of the immobile finger.

This species, like the *Pilumnus hirsutus* and *Cymodocea trilobata*, to be described in the second part of this Report, is a very common inhabitant of the Chinese seas, having been dredged at no fewer than nine different localities in or near the Korean Straits, at depths varying from 12 to 50 fathoms. Stimpson's specimens were from the Ly-i-moon Straits, near Hong-Kong.

MUNIDA JAPONICA.

Munida japonica, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 252 (1858).

A single specimen was collected in the Korean Straits, lat. 33° 14' N., long. 182° 55' E., at a depth of 40 fathoms. The legs are, unfortunately, wanting; but in the form of the carapace and rostrum, and the number and position of the spines of the cephalothorax, it agrees perfectly with Stimpson's description, whose specimens were collected at Kagosima, Japan.

¹ Ann. Sci. Nat. sér. 1, xix. p. 334 (1830); Hist. Nat. Crust. ii. p. 306 (1837); and Atlas, in Cuv. R. A. Crust. (ed. 3), pl. xliii. fig. 2.

² Rep. Brit. Assoc. p. 53 (1865); Ann. & Mag. Nat. Hist. ser. 4, ii. p. 115, pl. ix. fig. 3 (1868).

MACRURA.

THALASSINIDEA.

GEBIIDÆ.

GEBIA MAJOR.

Gebia major, De Haan, Faun. Japon., Crust. p. 165, pl. xxxv. fig. 7 (1849).

Several specimens are in the collection from Katsuma and Kada Bay, some obtained from coarse sand and gravel 18 to 20 inches below surface. The spinules on the upper margin of the hand, mentioned by De Haan, are very small, and concealed by the longer hairs, so as to be scarcely distinguishable.

CARIDEA.

CRANGONIDÆ.

PARACRANGON ECHINATUS.

Paracrangon echinatus, Dana, Proc. Ac. Nat. Sci. Phil. p. 20 (1852); U.S. Expl. Exp. xiii. Crust. i. p. 538, pl. xxxiii. fig. 6 (1852); Stimpson, Boston Journ. Nat. Hist. v. p. 497 (1857).

A single specimen, apparently a male, was collected north-east of Yedo Island, in lat. $44^{\circ} 27' N.$, long. $141^{\circ} 22' E.$, and differs in no respect whatever from the Californian species described by Dana, which was described from specimens dredged in Puget Sound, and of which authentic examples from California are in the Museum collection, presented by the Smithsonian Institution.

The occurrence of the single species known of this curious genus (which, with the hands of a *Crangon*, has the external appearance, elongate rostrum, &c. of a *Hippolyte*, and which is remarkable for the total obsolescence of the cephalothoracic legs of the second pair) on both sides of the Pacific Ocean is a noteworthy fact; and it is probable that, with further opportunities of comparison, other species will be shown to have a similarly extended range.

ALPHEIDÆ.

ALPHEUS.

There is probably scarcely any genus of Crustacea in which the species are more numerous, and which more greatly needs thorough revision than the present. Not only are the characters in themselves hardly to be defined and accurately appreciated without the aid of well-executed figures, but we do not know at present how far those which are generally adopted in distinguishing the species (*i. e.* the form and sculpture of the hands and the proportional length of the joints of the wrists of the anterior legs) may be modified by the age and sex of the individual. Under these circumstances it is not without considerable hesitation that I describe below two species as new, which, however, are distinct from any hitherto recorded, so far as I can judge from the materials available to me for comparison.

ALPHEUS BIS-INCISUS.

Alpheus bis-incisus, De Haan, Faun. Japon., Crust. pl. xlv. fig. 3 on plate, *Alpheus avarus* in text, l. c. p. 17; Stimpson, Proc. Ac. Nat. Sci. Phil. p. 30 (1860), nec *Alpheus avarus*, Fabricius, *vide* Stimpson.

Two specimens are in the collection, one female, in fine condition, obtained at Katsura, on the east coast of Japan, and a smaller individual, without definite locality.

Dr. Stimpson, in his report, quoted above, retains the name of *bis-incisus* for a species which he regards as distinct from the *Alpheus avarus* of Fabricius, with which, on the other hand, he considers the *Alpheus strenuus* of Dana (Expl. Exp., Crust. p. 543, pl. xxxiv. fig. 4), from Tongatabu, identical. Both species were collected in the American expedition to the North Pacific; and as I do not know the grounds on which he separated them, I follow for the present his nomenclature—although it would appear from comparison of the figures and descriptions that the *Alpheus bis-incisus* and *A. strenuus* are identical, while the *A. avarus* of Fabricius is described in such general terms that it would apply to several very different species; indeed by Milne-Edwards it is thought to be probably identical with *Alpheus brevirostris* of Olivier, which belongs to a different section of the genus from *A. bis-incisus* and *A. strenuus*.

ALPHEUS JAPONICUS, sp. n.

Carapace smooth. Rostrum narrow-triangular and acute, projecting rather beyond the orbits, which themselves project beyond the lateral margins of the carapace. Orbits without spines. Between the eyes and rostrum the carapace is very slightly concave. Second joint of the antennules not twice as long as the first. Anterior legs very unequal, the larger with the arm short, trigonous, enlarging distally, with a small spine at the distal end of its upper and lower margin; wrist very small, transverse; hand (with fingers) laterally compressed, very slightly contorted, nearly three times as long as broad; palm smooth, not cristate above, with the upper and lower margins straight and terminating in an acute lobe a short distance behind the articulation of the fingers; on the inner and outer sides of the palm, near the upper margin, is a longitudinal depression gradually obliterated towards the proximal extremity, that on the inner surface is narrow and triangulate, that on the outer broader and oblong in shape; the upper finger is broadest and rounded at its distal extremity, with a large tooth on its inner margin, fitting into a corresponding cavity on the inner margin of the lower finger; both are slightly hairy: the other anterior leg is slightly longer but very much more slender than the first described, which it resembles in the shape of the arm and wrist; the hand is very slender, smooth, and straight, no thicker than the wrist, the fingers hairy, and very slightly longer than the palm; the first joint of the wrist is longest, the third subequal and shortest, the fifth but little longer than the

third. The outer maxillipeds are densely hairy towards the extremities; the ambulatory legs slightly hairy on the penultimate joints.

Length of largest specimen about $1\frac{1}{2}$ inch.

Two specimens were collected:—one in lat. $34^{\circ} 6' N.$, long. $136^{\circ} 15' E.$, at 11 fathoms; the other in lat. $35^{\circ} 7' N.$, long. $136^{\circ} 55' E.$, at 3 fathoms, on a bottom of soft mud.

So far as can be judged from the descriptions of the numerous species of this genus, the one now described differs from all those of the same section (in which the rostrum rises from the margin of the front, the basal joint of the antennæ is without a spine, the larger hand excavated above and below, and the orbital margins without spinules) in the form and proportions of the anterior legs. The anterior legs somewhat resemble those of *A. bis-incisus* and *A. lobidens*, De Haan, but are much more slender and elongate, there is a spine at the distal end of both the upper and lower margins of the arms, and the lobes terminating the upper and lower margins of the larger hand are both acute.

ALPHEUS KINGSLEYI, sp. n.

Carapace smooth; upper orbital margins rounded and without spines. Rostrum acute, projecting little beyond the orbits, between the eyes very narrow-linear, and separated from them by deep depressions in the surface of the carapace. Antennules with the second joint of the peduncle more than twice as long as the first, and, like the antennæ, without a basal spine. Antennal scale narrow, with a prominent spine at its antero-external angle. Anterior legs very finely granulated, the margins of palms and fingers with long flexible hairs; in the larger (right) leg the arm is without spines at its distal extremity; wrist very small, transverse; hand (with fingers) rather more than twice as long as broad, laterally compressed; palm with its upper margin marked with two longitudinal lines of long hairs, and with a small transverse groove near the base of the mobile finger, inner and outer surface smooth, not carinated, outer surface slightly concave below upper margin, with a faintly-marked oblique impressed line near its base; lower margin straight, entire, subacute; fingers nearly as long as the palm, nearly straight, the upper broad and bluntly rounded at its distal extremity: the other leg is slender, smooth, the palm compressed, the fingers about twice as long as the palm, slightly arcuated, leaving a space between their inner margins, and crossing at the tips when closed. The second pair of legs has the first and second joints of the carpus each nearly as long as the three following together, the third and fourth joints being very short, the fifth but little longer. The dactyli of the following legs are slender and straight. Length about 1 inch 1 line.

One individual is in the collection, obtained with a specimen of the preceding species, in lat. $35^{\circ} 7' N.$, long. $136^{\circ} 55' E.$, at 3 fathoms, on a muddy bottom.

This species, on account of the form of the front and anterior legs, belongs to a small section of the genus *Alpheus* including the *A.*

brevirostris, Olivier, and *A. lobidens*, De Haan, and the *A. malabaricus* and *A. rapax*, Fabricius, as described and figured by the latter-mentioned author in the 'Fauna Japonica.' From the *A. brevirostris* it differs in the absence of crests upon the upper surface of the larger hand, the finger of which is proportionally much longer, and nearly straight, and from the three other species in the absence of ridges on the outer and inner surface of the palm, and of spines at the distal extremity of the arm, &c. It is evidently very nearly allied to *A. rapax*, which, however, is described (De Haan, *l. c.*) as having "*manus major glabra 4-costata, brachia carina superiore apice unispinosa.*"

I dedicate this species to Mr. J. S. Kingsley, of Salem, U. S., who, by his recent researches, has greatly facilitated the determination of the American species of this genus.

ALPHEUS GRACILIPES?

? *Alpheus gracilipes*, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 31 (1860).

I refer to this species with some hesitation a small individual collected in lat. $32^{\circ} 49' N.$, long. $128^{\circ} 54' E.$ It agrees in all particulars with Stimpson's description, based on a specimen from Tahiti, except that the orbits can scarcely be called acute in front, and the penultimate joint of the ambulatory legs is about 6-spined below. I may add that the larger hand is sparsely pilose and slightly twisted, the mobile finger about one third the total length of the hand. The smaller hand is wanting in the specimen.

RHYNCHOCYCLUS PLANIROSTRIS.

Cyclorhynchus planirostris, De Haan, Faun. Japon., Crust. p. 175, pl. xlv. fig. 7 (1849).

Rhynchocyclus planirostris, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 27 (1860).

Rhynchocyclus mucronatus, Stimpson, *l. c.* p. 28 (1860), var.

One adult female, with ova, was collected at Cape Sima, Nippon, at a depth of 18 fathoms, on a bottom of sand and broken shells, and one, apparently male, in the Gulf of Yedo. It is to be noted that in neither specimen is the wrist carinated above and spinose at apex, as in De Haan's description. In all other respects the female, however, agrees with the description and figure of that author. The second specimen, in the somewhat narrower longer rostrum, and the existence of but a single spine on the dorsal surface of the carapace, agrees with Stimpson's diagnosis of *R. mucronatus*, which was based on specimens collected in the Strait of Ly-i-moon, near Hong Kong; but the denticles on the anterior margin of the rostrum are more numerous in both individuals. In both, moreover, exist the spines on the anterior margin of the carapace, mentioned by Stimpson; and in both the joints of the wrist are of the same proportional length, *i. e.* the second longer than either the first and third. It is probable that Stimpson's species is at most a mere

variety of the *planirostris*; or the differences may be those peculiar to the male sex.

HIPPOLYTE LEPTOGNATHA, var.

? *Hippolyte leptognatha*, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 34 (1860).

Rather slender. Carapace dorsally carinated, the carina reaching nearly to the posterior margin; anterior margin with two small spines below the eye, and another at the antero-inferior angle. Rostrum elongated, longer than the carapace, its apex reaching beyond the end of the shorter thickened flagellum of the antennules; its upper margin straight, horizontal, and 6-dentate, the two or three last teeth situate on the dorsal crest, inferior margin with about six small and crowded teeth. The postabdomen is strongly geniculated. The outer maxillipeds slender and elongated, reaching nearly to the apex of the rostrum. Anterior legs rather slender; the palm longer than the fingers, and rather longer than the wrist. Wrist of second pair of legs 7-jointed, the second and sixth joints shortest, and the third joint the longest. Only one of the following legs exists in the specimen before me; in this the merus joint is armed with a series of spinules on its inferior margin, the penultimate joint is long, and the last joint short.

The single specimen, a female with ova, was collected in the Gulf of Yedo, and is in a mutilated condition.

It agrees in so many particulars with Stimpson's description of *H. leptognatha*, from Hakodadi, that I have not ventured to consider it distinct; as will be seen from the description, however, it differs in the more numerous teeth of the rostrum, of which fewer are placed on the dorsal surface of the carapace.

PANDALUS GRACILIS.

Pandalus gracilis, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 37 (1860).

A single specimen was obtained in the Korean Straits, in lat. 34° 8' N., long. 126° 24' E.; temp. of water 71°, at a depth of 17 fathoms. It is in a very mutilated condition, the legs being imperfect and rostrum broken at the tip; but it agrees well with Stimpson's description and a specimen presented by the Smithsonian Institution from Hakodadi.

PENÆIDEA.

PENÆIDÆ.

PENÆUS AFFINIS, M.-Edw.

Penæus affinis, M.-Edw. Hist. Nat. Crust. ii. p. 416 (1837); De Haan, Faun. Japon., Crust. p. 192, pl. xlv. fig. 3, *barbatus* on plate (1849); Miers, Proc. Zool. Soc. p. 304 (1878).

Penæus velutinus, Dana, U.S. Expl. Exp. xiii., Crust. i. p. 604, pl. xl. fig. 4 (1852).

One male individual, was collected in lat. 32° 49' N., long. 128° 54' E.

This species has apparently a very wide geographical range, as there are specimens which do not seem to differ specifically in the British Museum from the Gulf of Suez and Western Australia; and I am informed in a letter from Mr. J. S. Kingsley, of the Peabody Academy of Science, Massachusetts, that the Museum of that Institution possesses specimens from Hong-Kong, the Sandwich Islands, and Zanzibar.

CUMACEA.

HETEROCUMA, gen. nov.

Cephalothorax without a distinct rostrum, and (viewed laterally) nearly straight in its dorsal outline. Five free segments of the body exposed. Postabdomen much longer than the carapace, terminal segment obsolete. Eye large and distinct. Antennules robust, 5-jointed, without any accessory flagellum, and with the first three joints of the peduncle dilated. Mandibles with the apex strongly dentated, the inner margins armed with 10-12 stiff setæ and with a prominent molar tubercle. First maxillæ with the slender flagella terminating in two unequal setæ. First and second maxillipeds 6-jointed; third maxillipeds 6-jointed, the basal joint considerably dilated, and produced at its extero-distal angle, which is subacute, the second joint very short, transverse, the third with its extero-distal angle greatly produced and acuminate, the fourth dilated and truncated at its distal extremity, and the fifth and sixth slender. First three pairs of legs palpigerous in both sexes. The appendages of the sixth postabdominal segment (uropoda) are elongated, the basal portion being about as long as the fifth postabdominal segment, and terminating in two flattened subequal rami, which are two-jointed and about as long as the base.

In the males there exist well-developed appendages on the ventral surface of the first five postabdominal segments, and the antennæ are well developed and have the last joint of the peduncle dilated and terminate in a slender flagellum, which is directed backward and is as long as the animal.

This genus is apparently nearly allied to *Eudorella*, Norman (*Eudora*, S. Bate), which it resembles in general form, the obsolescence of the terminal postabdominal segment, the form of the uropoda, &c., but differs in the existence of a well-developed eye, in the structure of the flagellum of the first maxilla, which terminates in two setæ, and particularly in the dilatation of the third and fourth joints of the third pair of maxillipeds. In the males, moreover, the first five postabdominal segments are all furnished with appendages.

It is also very nearly allied to *Leptocuma*, Sars, from Rio Plata, a genus recently described and beautifully figured by its distinguished author in Kongl. Vetensk.-Akad. Handl. xi. no. 5, p. 24; but in that genus the eye is indistinct, and not furnished with corneæ, the first pair of legs more robust, and, moreover, the third maxillipeds (so far as they could be seen without dissection in the unique specimen) are described as "of perfectly normal structure" in *Leptocuma*.

HETEROCUMA SARSI, sp. n. (Plate III. fig. 3.)

The body is slender; the carapace or dorsal shield is somewhat laterally compressed, with an obscure median dorsal keel, which is flattened and sulcated posteriorly, and terminates anteriorly in the oculigerous lobe. Viewed laterally, the dorsal outline of the carapace is nearly straight, the inferior or lateral margin is at first straight and parallel with the upper, but anteriorly it is curved upward toward the front. The antero-lateral margins meet in front of the eye, but are not prolonged into a rostrum. The surface is smooth, or only very minutely punctulated; on either side there is a wide and rather deep incision in the antero-lateral margin, through which the antennules are visible; and the lobe beneath the sinus is triangular and subacute.

Five free segments of the body are exposed, the first being very narrow and overlapped upon the sides by the carapace; the second is longest, with the latero-inferior margins straight; the third very short upon the dorsal surface, but, like the two following, produced backward at its postero-lateral angle. Similarly the first four post-abdominal segments are produced backward on the sides, the produced portion forming a subacute lobe; these segments are subequal, the fifth is longer, the sixth rather smaller than any of the preceding; all are marked with longitudinal depressions on the dorsal surface, which are best visible in the dried specimens; the last segment or telson is represented only by an obscurely bilobate tubercle.

The large black eye is placed immediately behind the frontal margin. The antennules, visible through the lateral sinus, are short and 5-jointed, the basal joint very short, the second longest and considerably dilated, the third dilated and shorter, the fourth slender and longer, and the fifth very small and ending in a pencil of setæ. The first pair of legs are greatly elongated and slender, the extremity being clothed with a pencil of long setæ, which arise near the distal end of the penultimate joint; the fifth pair of legs is very short. The appendages of the first five postabdominal segments in the male are biramose; the rami flattened, ovate, and fringed at their distal extremities with long and flexible cilia; those of the sixth segment (uropoda) are fringed with short stiff setæ along the inner margins of the base and the inner ramus, of which the two joints are subequal; in the outer ramus the basal joint is much shorter than the terminal. Length of animal (excluding appendages) not exceeding $\frac{3}{4}$ inch.

A good series of specimens of both sexes were collected at a depth of 40 fathoms in lat. $32^{\circ} 41' N.$, long. $128^{\circ} 57' E.$; one (a male) occurred at a depth of 50 fathoms, in lat. $33^{\circ} 19' N.$, long. $129^{\circ} 7\frac{1}{2}' E.$; and two males and a female were taken in lat. $32^{\circ} 49' N.$, long. $128^{\circ} 56' E.$

Var. GRANULATA.

In two or three specimens (male and female), collected, with the typical form, in 40 fathoms, in lat. $32^{\circ} 41' N.$, long. $128^{\circ} 57' E.$,

the carapace is more or less covered on its dorsal surface with small tuberculiform granules, which are largest along the line of the median dorsal carina, and are gradually obliterated toward the lateral margins.

As in all other respects these specimens resemble the typical forms, I have not ventured to regard them as belonging to a distinct species¹.

APPENDIX.

On the Method of Dredging and Separating the Specimens, &c., with Remarks on Temperature, &c. By Capt. H. C. ST. JOHN, R.N.

During the years 1870 to 1877, when employed surveying the Japanese coasts, I usually kept a small dredge pretty well at work.

There is so little trouble and the few arrangements necessary are so simple, that I venture to give a brief outline of the plan I adopted, hoping, if it meets the eyes of those who have business on the deep, that they might be induced, at any rate occasionally, to try their luck in a similar way.

After ascertaining the depth, the dredge (which was always kept ready, hanging over the stern) would be lowered into the water, a 28-pound lead attached to the rope 5 to 8 fathoms from the dredge; this is to ensure the dredge passing over or along the bottom at the right angle. If the ship is just moving through the water, so much the better; the dredge then goes out clear. I think about one mile an hour not too fast for the dredge to pass along the bottom, and half an hour generally long enough for it to remain down.

On its being brought up, a boy, whom I had shown how to sift the contents, immediately commenced operations, using three diffe-

¹ To complete the account of the Podophthalmia collected by Capt. St. John, I subjoin the following description of a Stomatopod crustacean without definite locality, which, being represented only by a single specimen in mutilated condition, I cannot determine with certainty. It is apparently allied to *Cyrtopia*, Dana. The carapace, which loosely covers the body, is attached only near its anterior margin, and is deeply excavated posteriorly on the dorsal surface, leaving three or four segments of the cephalothorax exposed. Anteriorly, it is prolonged forwards between and half conceals the eyes, and is armed with a strong median and two small lateral frontal spines; beneath the eyes there are two small spines on the lateral margins, and one on the postero-lateral lobe on either side of the median excavation. The surface of the carapace is covered with small scattered granules. The postabdominal segments are nearly smooth; the sixth has two teeth on its lateral margins. The terminal segment is entire, tapers slightly to its distal extremity, which is subtruncate and armed with two strong stiff setæ. The eyes are large, red, and only slightly project from beneath the margins of the carapace. The antennules have the peduncle thickened, and are furnished with two flagella, which are broken; but the outer in its imperfect state is nearly as long as the animal. The antennæ are furnished at base with an ovate leaf-like scale, and have each a single flagellum (unfortunately broken). The cephalothoracic legs are in very imperfect condition; but there seem to have existed six pairs, furnished (at least the anterior pair) with a palp and a branchial leaflet at base. The first five postabdominal segments are furnished with swimming-appendages; the appendages of the sixth segment have subequal rami, ciliated along their inner margins, the outer ovate-lanceolate, and the inner lanceolate and acute. Length about 9 lines ($\frac{3}{4}$ inch).

rent-sized sieves for the purpose, and placing every thing he found in a wooden tub filled with clean salt water. From this receptacle I always took the specimens myself, putting them at once into bottles with spirit. In working the contents of the dredge, care should be taken that the hand is not used to rub or force them through the sieves. The sieves ought to be shaken backwards and forwards in a tub of water; the sand or mud will quickly pass away, leaving all but microscopic life behind.

I usually kept a small canvas bag of the contents of the dredge previous to its being examined and just as it came up. If hung up, the contents of the bag soon harden and dry; it takes little room, and frequently contains interesting subjects for microscopic examination.

Generally quantities of animal life came up attached to the bag, outside as well as in. It is always well to examine the bag closely immediately the dredge reaches the surface. The small colourless and otherwise difficult-to-distinguish forms which abound in about 50 fathoms will then be more easily found by their movements, whereas if left to die, which they very soon do, they are far more difficult to find.

As the depth of water increases, so ought the distance of the 28-pound lead from the dredge, so as to ensure the lips of the dredge taking the bottom at a proper angle. I used a 2½-inch rope next the dredge, increasing that size at 200 fathoms to 3 inches.

The dredge was about 3 feet long by 18 inches wide. This size I found most convenient, the bag being about 3 feet 6 inches deep, and made of ordinary bread-bag stuff, with a good strong network bag outside to protect the inner or real bag from being torn or injured on the hard bottom.

During the seven years I spent in Japan most of the time was on the south coast, where, in consequence, the chief part of the dredgings were obtained. In 1871, however, I had an opportunity of dipping into the cold stream from the north, as it flowed past the north and north-east coast of Yedo. The temperature of this stream was 36° to 39° F. in the month of August, whereas that of the Kuro Siwo or equatorial current, a small portion of which enters the Sea of Japan by the Korean Strait and passes out to the Pacific by the Tsuga Strait, was 58° to 60° at the same time, and in close proximity to the counterstream. These two currents rub together, but do not mix.

From the cold waters the most interesting things were obtained; and I feel sure there is much to be done in this particular portion of the globe, which may be termed the north-west corner of the Pacific.

When practicable, I always took the temperature at the bottom as well as at the surface.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Pleistacantha sancti-johannis* (p. 24), male individual, natural size.

- 1 *a.* Inferior view of buccal, orbital, and antennal region of the same. $\times 3$ diameters.
- 1 *b.* Lateral view of rostrum. $\times 3$ diameters.
- 1 *c.* Outer view of hand of the same. $\times 3$ diameters.
- 1 *d.* Postabdomen of the same. $\times 3$ diameters.
2. *Hyastenus* (*Chorilia*) *japonicus* (p. 27), male individual, dorsal view, natural size.
- 2 *a.* Orbital and antennal region of the same. $\times 2$ diameters.
- 2 *b.* Postabdomen of the same. $\times 2$ diameters.

PLATE II.

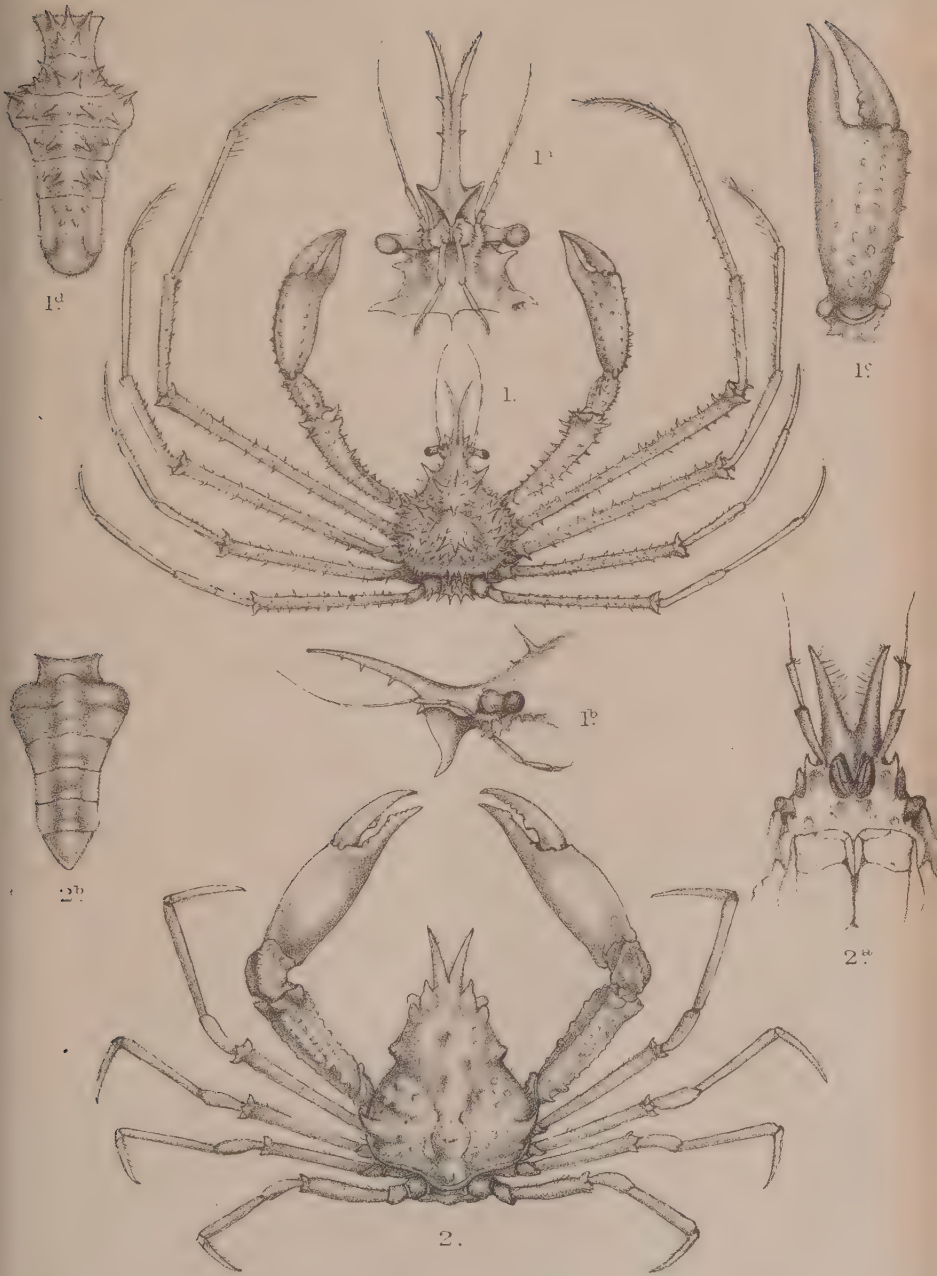
Fig. 1. *Doclea orientalis* (p. 28), female individual, natural size.

- 1 *a.* Inferior view of orbital and antennal region of the same. $\times 3$ diameters.
2. *Heteroplax* ? *nitidus* (p. 39), female individual. $\times 2$ diameters.
- 2 *a.* Inferior view of frontal, orbital, and antennal region of the same, further magnified.
- 2 *b.* Outer view of hand of the same. $\times 4$ diameters.
3. *Heterograpsus longitarsis* (p. 37), male individual, natural size.
- 3 *a.* Outer view of hand of the same. $\times 3$ diameters.
4. *Pseudophilgyra tridentata* (p. 41), male individual. $\times 3$ diameters.
- 4 *a.* Outer view of hand of the same. $\times 2$ diameters.
5. *Cryptocnemus pentagonus*, Stimpson (p. 43), carapace of male individual. $\times 3$ diameters.
6. *Paratymolus pubescens* (p. 45), female individual. $\times 3$ diameters.
- 6 *a.* Inferior view of buccal, antennal, and orbital region of the same. $\times 8$ diameters.
- 6 *b.* Lateral view of carapace of the same. $\times 3$ diameters.

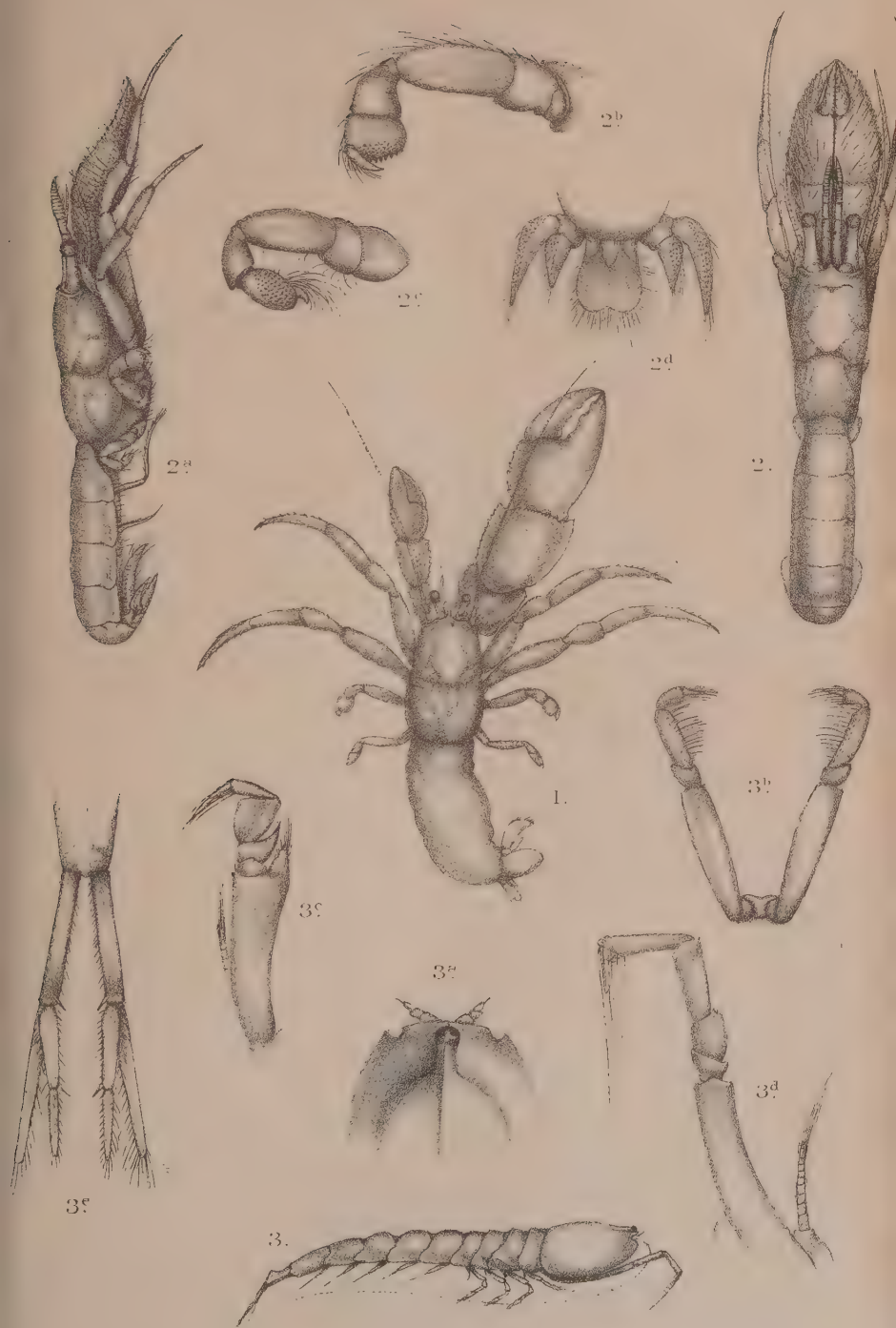
PLATE III.

Fig. 1. *Eupagurus cavimanus* (p. 48), male individual. $\times 1\frac{1}{2}$ diameter.

2. *Pomatocheles jeffreysii* (p. 49), male individual, dorsal view. $\times 4$ diameters.
- 2 *a.* Lateral view of the same. $\times 4$ diameters.
- 2 *b.* Fourth cephalothoracic leg of the same, greatly magnified.
- 2 *c.* Fifth cephalothoracic leg, greatly magnified.
- 2 *d.* Terminal segment and uropoda, greatly magnified.
3. *Heterocuma sarsi* (p. 58), male individual. $\times 3$ diameters.
- 3 *a.* Front of cephalothorax, dorsal view, further magnified.
- 3 *b.* Second maxilliped, greatly magnified.
- 3 *c.* Third maxilliped of the same, greatly magnified.
- 3 *d.* Leg of the first pair, greatly magnified.
- 3 *e.* Terminal segment and uropoda, greatly magnified.







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With the author's compliments
23/1/79

REVISION

OF

THE *HIPPIDEA*.

BY

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(PLATE V.)

Introductory Remarks.—The determination of the different species of this small and peculiar group of Anomurous Crustacea, and their identification with the brief descriptions of the earlier authors, are often very difficult. Where the type specimens no longer exist, it must of necessity remain uncertain what species were known to Linnæus and Fabricius. But three or four species are mentioned by Lamarck and Latreille; and only five are described by M. Milne-Edwards in the second volume of the 'Histoire Naturelle des Crustacés' (1837). In the twenty years following the publication of that work the number of species was more than quadrupled, as we find that Stimpson, in 1858, in the preliminary Report on the Crustacea collected by the United States Expedition to the North Pacific, enumerates (but does not describe) 23 species, contained in 6 genera; and since the publication of his list several additional species have been described. In the present revision of the group I have endeavoured, as far as the state of our knowledge and the materials afforded by the extensive collection of the British Museum will permit, to determine the geographical range and the extent of individual variation in the several species, and to indicate reliable characters by which they may be distinguished; but as several species are either *desiderata* or insufficiently represented in the national collection, there yet remain several points requiring further elucidation.

Three new species are described; but as several of those previously recorded are reduced to the rank of synonyma, the total number is only 22.

It may be desirable to present a brief summary of the views held by the different authors upon the classification and affinities of the *Hippidea*, beginning with Latreille, who, by his researches, may be considered to have laid the foundation of the natural arrangement of the Crustacea. By this author (Gen. Crust. et Ins. i. p. 44, 1806) the genera *Remipes*, *Hippa*, and *Albunea* were arranged in the family *Paguriens* of the tribe *Macroures*; but he subsequently (Cuvier R. A. ed. 1, iii. p. 27, 1817) constituted a distinct section, *Anomaux*, to contain these genera, together with the *Paguridæ*, *Porcellanidæ*, and *Galatheidæ*. Lamarck (Hist.

Nat. Animaux sans Vert. v. p. 218, 1818), observing the external relationship of the *Hippidæ* with *Ranina*, arranged them with the latter genus in a distinct section of the family, characterized by the lamellated terminal joints of the legs.

M. H. Milne-Edwards (Hist. Nat. Crust. ii. p. 167, 1837) considered the *Hippiens* a distinct tribe of the family *Pterygures* of his *Crustacés Anomoures*, but regarded them as allied to the *Raninidæ* (p. 198).

De Haan ("Crustacea," in 'Fauna Japonica,' dec. vi. p. 195, 1849) retains in a somewhat wider sense the division *Anomala* of Latreille, in which he includes the *Hippideæ*, recognizing (p. 136) their relationship to the *Raninidæ* in external appearance and the form of the legs, from which, however, he points out they are widely separated in the form of the pterygostomial regions, number of the branchiæ, and characters of the sternum and postabdomen.

By Dana (Crustacea in U.S. Explor. Exped. xiii. pp. 51 & 402, 1852) a very different view is taken of the affinities of these animals. This author traces with great care and accurate knowledge the relations of the different groups of Anomura with the higher Brachyural types, of which they are severally degraded forms, showing that they may, with equal propriety, be classified (a) as in a linear descending series they deviate from the Brachyural to the Macrural type, or (b) according to their respective natural affinities with the higher Brachyural subtribes. In the former system the *Hippideæ* are ranked by him with the *Porcellanideæ*, as constituting the second section, *Anomoura media*, of the tribe *Anomoura*; in the latter they are classed as *Anomoura Corystidica*, immediately beneath the *Corystoideæ*, which latter are undoubtedly *Cancroid* Crustacea. With all deference to the opinion of the distinguished American naturalist, I must regard the older view of their affinities as the more correct.

Although in their elongated carapace and antennæ the *Hippideæ* have a considerable resemblance to certain of the *Corystoideæ*, as will be seen, e. g., by comparing the Chilian *Blepharopoda spinimana* and *Pseudocorystes sicarius*, I believe their true affinities are with the Oxystomatous Brachyura, through the *Raninidæ*. They resemble these latter in their narrow and elongated form, natatorial legs, and, in the case of the *Albuneidæ*, in the high and laterally compressed hands of the anterior legs, which altogether resemble those of the Oxystomatous *Calappa* and allied genera. On account of the imperfect definition of the buccal cavity, it is

not easy to trace any resemblance either to the *Cancroidea* or to the *Oxystomata* in the form of the mouth and oral appendages. There exists, however, an important characteristic, and one, I believe, not hitherto noted, in the form of the terminal lobe of the exognath of the first pair of maxillipedes, which in the *Hippidea* is elongated and narrow, as in the *Oxystomata*, where it is usually applied to the opening of the efferent branchial channel. In the *Cancroidea* and *Oxyrhyncha* this joint is more or less obtriangular, short, and truncated at its distal extremity.

Stimpson, in the Report already referred to (Proc. Ac. Nat. Sci. Philad. p. 229, 1858), places the *Hippidea* in the second section, *Schizosomi*, of the Anomura. He establishes the two very distinct and natural families, *Hippidæ* and *Albuneidæ*, gives diagnoses of the known genera, and adds two, previously unrecorded, to the list*.

Geographical Distribution.—The *Hippidea* inhabit all the warmer temperate and tropical seas of the globe. *Remipes testudinarius*, one of the most variable, is also the most widely distributed species, occurring throughout the whole Indo-Pacific region, from the east coast of Africa, along the southern and south-eastern coast of Asia, in Australia, through the islands of the Pacific, to the Galapagos and Cape St. Lucas in California. Another species, *R. scutellatus*, is found on both the eastern and western shores of the Atlantic Ocean. The majority of the species of the family appear, however, to be somewhat restricted in their range. Those belonging to the family *Albuneidæ* are, with two exceptions, restricted to the American continent, where these Crustacea are especially abundant. The only species at present certainly known to inhabit the seas of Europe is *Albunea guerinii* from the Mediterranean.

List of the Species of Hippidea.

Fam. HIPPIDÆ.

REMIPES.

<i>Names of the Species.</i>	<i>Geographical Range.</i>
1. <i>R. testudinarius</i> , Latr.	Whole Indo-Pacific region.
,, var. <i>denticulatifrons</i> .	,,
2. <i>R. scutellatus</i> (Fabr.).	Florida, West Indies, West coast of Africa, Cape-Verd Islands, Ascension Island.

* Dr. Claus ('Untersuch. Crust. Syst.' pp. 59-61, Wien 1876) rejects the suborder Anomura, and refers the *Hippidea* to the Brachyura on account of what is known of their development. I regret that I have not yet had an opportunity of studying this important work.

Names of the Species.

Geographical Range.

- | | |
|---------------------------------------|-------------|
| 3. <i>R. strigillatus</i> , Stimpson. | California. |
| 4. <i>R. truncatifrons</i> , n. sp. | China. |

MASTIGOCHIRUS.

- | | |
|-------------------------------------|--------------|
| 1. <i>M. gracilis</i> , Stm. | China. |
| 2. <i>M. quadrilobatus</i> , n. sp. | Philippines. |

HIPPA.

- | | |
|---------------------------------|---|
| 1. <i>H. emerita</i> (Linn.). | Eastern coast of America (Cape Cod to Brazil). |
| 2. <i>H. analoga</i> , Stm. | Western coast of America (California to Chili). |
| 3. <i>H. asiatica</i> , M.-Edw. | Indian Ocean, Indo-Malayan archipelago. |

Fam. ALBUNEIDÆ.

ALBUNEA.

- | | |
|--|---|
| 1. <i>A. symnista</i> (Linn.). | Indian Ocean, Indo-Malayan archipelago. |
| 2. <i>A. guerinii</i> , Lucas. | Gulf of Algiers. |
| 3. <i>A. microps</i> , White, MS. | Sooloo Island. |
| 4. <i>A. gibbesii</i> , Stimpson. | South-east coast of United States. |
| 5. <i>A. oxyophthalma</i> , Leach (ined.). | West Indies, Cayenne, Brazil. |
| 6. <i>A. lucasii</i> , Saussure. | Mazatlan. |
| 7. <i>A. speciosa</i> , Dana. | Sandwich Islands. |

LEPIDOPS.

- | | |
|----------------------------------|------------------------------|
| 1. <i>L. scutellata</i> (Desm.). | Peru ? St. Thomas. |
| 2. <i>L. venusta</i> , Stm. | West Indies (St. Thomas). |
| 3. <i>L. myops</i> , Stm. | California (Cape St. Lucas). |

BLEPHAROPODA.

- | | |
|---|-------------|
| 1. <i>B. spinimana</i> (Philippi). | Chili. |
| 2. <i>B. occidentalis</i> , Randall. | California. |
| 3. <i>B. spinosa</i> , M.-Edw. and Lucas. | Peru. |

As to Habits.—Until quite recently but little was known respecting the life-history and habits of the *Hippidea*; but Mr. S. I. Smith has, in his most interesting and valuable memoir on the early stages of *Hippa talpoidea* (Trans. Connect. Acad. iii. 1877), furnished a fully detailed account of the development of the common species of the Eastern shores of the United States. He states, with regard to its habits, that this animal is far more abundant on the sandy coasts of the Southern United States, and gives reasons for believing that the northern range of this, as of

many other southern species, is restricted by the extreme cold of the winters*.

He states, moreover, that *H. talpoidea* lives gregariously, burrowing in the loose and changing sands at or very near low-water mark, but that it is occasionally found swimming about in pools left by the tide, and when undisturbed sometimes comes out and swims in the same way along the shore, although probably never venturing far from the bottom.

It may be noted that Dana found his specimens of *R. hirtipes* swimming along the sandy bottom in shallow waters, near the shores of a small island off Soung, the principal harbour of the Sooloo Islands. Occasionally, however, these animals are collected at greater depths. Thus Lucas collected his specimens of *Albunea guerinii* at depths of 16–21 fathoms in the Gulf of Algiers; and *Mastigochirus gracilis*, Stimpson, was collected on a shelly bottom at a depth of 20 fathoms, at the island of Ousima. So also specimens of the rare *Blepharopoda spinimana* in the British-Museum collection were obtained by fishermen in deep water in the Bay of Valparaiso.

Fam. HIPPIDÆ.

Hippidæ, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 229 (1858).

Anterior legs not subcheliform. Antennæ with the accessory joint minute or obsolete. Third maxillipedes suboperculiform, the third joint greatly enlarged and without an exognath; last tail-segment greatly elongated, lanceolate, and acute at the extremity.

REMIPES.

Remipes, *Latr. Gen. Crust. et Ins.* p. 45 (1806); *M.-Edw. Hist. Nat. Crust.* ii. p. 204 (1837); *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 229 (1803).

Antennules of moderate length. Antennæ very short. Third maxillipedes with the last joint somewhat unguiform. First legs elongated, subcylindrical, robust; the last joint not annulated, styliiform, similar to the preceding.

REMIPES TESTUDINARIUS. Pl. V. fig. 1.

? *Hippa adactyla*, *Fabr. Ent. Syst.* ii. p. 474 (1793), *Suppl.* p. 370 (1798); *Latr. Hist. Nat. Crust.* vi. p. 176 (1803).

* The advance northwards of species common to the east coast of North America is probably checked by the cold Arctic current which impinges on the shores of the United States and flows southwards between the coast and the warm waters of the Gulf Stream?—EDITOR.

Cancer emeritus, *Herbst, Naturg. Krabben u. Krebse*, ii. p. 8, pl. xxii. fig. 4 (1796), *nec Linn.*?

Remipes testudinarius, *Latr. Gen. Crust. et Ins.* i. p. 45 (1806); *Lam. Hist. Anim. sans Vert.* v. p. 223 (1818); *Desm. Consid. Crust.* p. 175, pl. xxix. fig. 1 (1825); *M.-Edw. Hist. Nat. Crust.* ii. p. 406, pl. xxi. figs. 14-20 (1837); *Crust. in Cuvier R. A.* (ed. 3), *Atlas*, pl. xlii. fig. 1; *Guérin-Ménév. Icon. R. A. Crust.* pl. xv. fig. 3; *Heller, Reise der Novara, Crust.* p. 72 (1865); *Hilgendorf, Crust. in Van der Decken's Reisen in Ost-Afrika*, iii. p. 94 (1869).

Remipes marmoratus, *White, List Crust. Brit. Mus.* p. 58 (1847), *sine descr.*

Remipes pacificus, *Dana, U.S. Expl. Exp.* xiii. *Crust.* i. p. 407, pl. xxv. fig. 7 (1852); *Stimpson, Ann. Lyc. Nat. Hist. New York*, vii. p. 241 (1862); *Miers, P. Z. S.* (1877) p. 74.

Remipes hirtipes, *Dana, l. c.* p. 408, pl. xxv. fig. 8 (1852).

Remipes marmoratus, *Jacq. et Lucas, Crust. in Voy. Pôle Sud, Zool.* iii. p. 97, pl. viii. figs. 22-26 (1853); *Miers, Cat. New-Zeal. Crust.* p. 59 (1876).

Remipes pictus, *Heller, Crust. Rothen Meeres, in Sitzungsab. Ak. Wiss. Wien*, xlv. i. p. 243 (1862).

Remipes ovalis, *A. M.-Edw. Faune Carcinol. in Maillard, Ile Réunion*, ii. *Annexe F*, p. 12, pl. xvii. fig. 5 (1863).

Moderately convex, the carapace marked with numerous fine interrupted transverse lines, postfrontal sinus usually distinct. Frontal lobes moderately prominent, obtuse, and rounded, the lateral lobes (in the typical form) scarcely projecting beyond the median ones. Sides of the carapace with a series of shallow pits bordered with tufts or lines of short hairs, forming a linear sub-marginal striated area. Eye-peduncles slender, and usually extending a little beyond the end of the basal joint of the antennules, which, like the antennæ, are short and clothed with longish hairs. Anterior legs elongated, and clothed with rather long hairs, which are densest on the inner margins, and show a tendency to disposition in oblique series on the upper and outer margins of the last two joints; the last joint is similar to the preceding, and tapers somewhat to its extremity, which is clothed with long hair. The second, third, and fourth pairs of legs are robust; the terminal joint of the second and third pairs but slightly falcate, its distal half short, broad, and obtusely rounded at the extremity; that of the fourth pair narrow and straight. Rami of the appendages of the penultimate postabdominal segment ovate and unequal, the inner the larger. Terminal segment elongated, oblong-lanceolate.

Hab. Australian Seas (*Coll. Mus. Paris, Brit.*); Red Sea (*Heller*); Mauritius (*Coll. Mus. Brit.*); Zanzibar (*v. der Decken*); Réunion (*Maillard*); Nicobars (*Heller*); Sooloo Island (*Dana*); Moluccas, Flores (*v. Martens*); Philippines (*Coll. Brit. Mus.*); Ousima (*Stimpson*); New Hebrides, Mallicollo (*Coll. Brit. Mus.*); Fiji Islands, Ovalau (*Dana; Coll. Brit. Mus.*); Samoa or Navigators' Islands (*Coll. Brit. Mus.*); Sandwich Islands (*Dana*); Tahiti (*Heller, Coll. Brit. Mus.*); California, Cape St. Lucas (*Stimpson, Coll. Brit. Mus.*).

This species, as has already been observed, is the most common and widely distributed of the family, and varies somewhat in the form of the frontal lobes, tarsal joints, &c. In the figure given by Milne-Edwards, in the 3rd edition of Cuvier's 'Règne Animal,' and Guérin in the 'Iconographie,' and in specimens observed by Hilgendorf from Zanzibar, as in one specimen in the British-Museum collection, from Australia, there is a small tooth in the notch separating the median frontal teeth; but this peculiarity can hardly be considered to indicate a distinct variety of the species. The greater number of the specimens in the Museum are of the female sex; and between these and the males I have not remarked any striking sexual distinctions; the terminal segment of the male, however, is narrower than that of the female. The length of the carapace of the largest specimens in the collection does not exceed $1\frac{1}{3}$ in.

I have not discovered among the Banksian specimens now in the British Museum the type specimen of Fabricius's *H. adactyla*, which has been referred to by Milne-Edwards as synonymous with this species, but is described as having "*cauda inflexa, articulo primo longitudine thoracis*," which certainly does not apply to it; and I therefore retain the designation *testudinarius*, by which it is generally known.

I follow Hilgendorf in uniting *R. pictus*, Heller, and *R. ovalis*, Edw., with this species, as no characters are given which suffice to distinguish them from the common form. The same may be said of *R. pacificus* and *hirtipes*, Dana: of the former species specimens from the Smithsonian Institution are in the British-Museum collection which certainly belong to *R. testudinarius*.

Var. DENTICULATIFRONS. Pl. V. fig. 2.

Remipes denticulatifrons, *White, List Crust. Brit. Mus.* p. 57 (1847), sine descr.

In this variety the lateral lobes of the front are narrower, spiniform or tuberculiform, and project beyond the level of the median lobes. The frontal margin in the adult is denticulated. The striations of the lateral margins are smaller than in the typical variety, forming a very narrow marginal band. The terminal joint of the second and third pair of legs is much more strongly falcate, its distal half narrower, and its apex more acute.

Hab. Zanzibar; Philippine Islands, Maibate; Java; New Hebrides, Aneiteum; Loyalty Islands, Lifu; Galapagos, Charles Island (*Coll. Brit. Mus.*).

The characters of this variety are so marked in the adult that I was at first inclined to consider it a distinct species; but they are much less evident in the young animal. Most of the specimens I have examined are of the female sex; but the characters are not sexual, as there are adult females of the preceding variety in the collection. It would appear, from the localities given above, that the range of this form is equal in extent to that of the typical variety. The largest specimen, that to which White originally applied the name, is much larger than any other of the genus which I have seen—the carapace having a length of $1\frac{2}{3}$ inch, and greatest breadth of $1\frac{1}{2}$ inch.

REMIPES SCUTELLATUS.

Squilla barbadensis ovalis, *Petiver*, *Pterigraph. Amer.* pl. xx. fig. 9.

Hippa scutellata, *Fabr. Ent. Syst.* ii. p. 474 (1793).

Remipes scutellatus, *List Crust. Brit. Mus.* p. 57, sine descr. (1847).

Remipes cubensis, *Saussure, Rev. et Mag. Zool.* ix. pp. 304, 308 (1857);
Mém. Soc. Phys. et Hist. Nat. Genève, xiv. p. 452, pl. ii. fig. 19 (1858).

Remipes barbadensis, *Stimpson, Ann. Lyc. Nat. Hist. New York*, x. p. 120 (1871).

Body depressed, broad. Front very broad, anterior margin sinuated on either side of the very slightly prominent median frontal lobe, which is less acute than in *R. strigillatus*. The obliquely striated area forms a narrow marginal band on each side of the carapace, and is but very little broader posteriorly. Eye-peduncles short, projecting but very little beyond the penultimate joint of the antennules—which is scarcely visible from above, beyond the frontal margin of the carapace. Anterior legs of moderate length; terminal joint slightly compressed, with two strong oblique setose ridges on its extero-inferior surface. Ter-

minal joints of the second and third pairs of legs falcate, with the distal as long as, and slenderer than the proximal half. Inner ramus of the appendages of the penultimate segment longer than the outer. Terminal segment elongated-lanceolate. Length of carapace of largest specimen nearly 1 inch.

Hab. Cuba (*Saussure, Coll. Brit. Mus.*); Barbadoes (*Prof. Gill, Coll. Brit. Mus.*); Key Biscayne, Florida (*G. Wurdemann*); St. Christopher's (*Coll. Brit. Mus.*); St. Vincent, Cape-Verdes (*Cunningham, Coll. Brit. Mus.*); Ascension Island (*Coll. Brit. Mus.*); West Africa (*Coll. Brit. Mus.*).

There can be little doubt that the *R. cubensis* of Saussure and *R. barbadensis* of Stimpson are identical. Stimpson does not indicate any distinct specific characters in his description of the latter species; and there are even specimens from Barbadoes in the British-Museum collection, received from the Smithsonian Institution, labelled *R. cubensis*. The specimens named by Dr. Leach *R. scutellatus*, and mentioned by White in the 'List of Crustacea' (*l. c.*), which in all probability were the type specimens of the *Hippa scutellata* of Fabricius, are the types of my description of this species. It is to be observed, however, that Fabricius in his short description says, "*manibus chelatis; chelæ læves.*" It is possible that Fabricius mistook the maxillipedes, which present a subchelate appearance when applied to the buccal cavity, for the anterior legs. His description as it stands would certainly apply better to a species of *Lepidops*, to which it is considered to belong both by the earlier authors and Dr. Stimpson.

REMIPES STRIGILLATUS. Pl. V. figs. 3, 4.

Remipes strigillatus, *Stimpson, Ann. Lyc. Nat. Hist. New York*, vii. p. 241 (1862).

Body much depressed, broad. Front very broad, with a very slightly projecting median frontal lobe, anterior margin nearly straight, entire, smooth. The obliquely striated area on the sides of the carapace very broad in its posterior half, where it occupies one fourth of the width of the carapace, striæ sharp, minutely setose, not interrupted, but extending quite to the margin. Eye-peduncles short, reaching to the end of the penultimate joint of the antennules. First pair of legs short, terminal joint slightly compressed, with two strong oblique setose ridges on its extero-inferior surface. Terminal joints of the second and third pairs of legs short, broad, obtuse, and very slightly falcate. Inner

ramus of the appendages of the penultimate segment but little longer than the outer. Last segment oblong-lanceolate.

Hab. Cape St. Lucas (*Stimpson, Coll. Brit. Mus.*).

The broad striated area on the sides of the carapace at once serves to distinguish this species. The three specimens of this species in the British-Museum collection from the Smithsonian Institution are of small size, length of the carapace of the largest not exceeding $\frac{7}{12}$ inch (Stimpson gives 1 inch as the length of the carapace). The median frontal projection is very obscure; and in one specimen the anterior margin appears nearly straight.

REMIPES TRUNCATIFRONS, sp. n. Pl. V. figs. 5, 6.

Body depressed; frontal margin straight, entire, smooth, with scarcely any trace of a median frontal lobe. Sides of the carapace without any trace of the defined striated marginal area existing in other species of the genus. Eye-peduncles very slender, projecting but little beyond the rather prominent penultimate joint of the antennules; cornea small, subterminal. Anterior legs small and slender; terminal joint of the second and third pairs of legs short, broad at base, distinctly falcate, with the distal portion much slenderer than the proximal. Outer ramus of the appendages of the penultimate segment of the postabdomen much shorter than the inner. Terminal segment oblong-lanceolate.

Hab. China (*J. R. Reeves, Esq., Coll. Brit. Mus.*).

The obsolescence of the median frontal lobe, and the absence of a lateral marginal striated area, serves to characterize this species. The eye-specks, viewed from above, are placed at a little distance from the distal extremity of the peduncle. The single specimen in the British-Museum collection is a female. Length of carapace $\frac{7}{12}$ inch.

MASTIGOCHIRUS.

*Mastigopus**, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858) (nom. præoc.).

Antennules and antennæ short. Third maxillipedes rather slender. First legs very long and very slender, with the last joint especially greatly elongated and multiarticulate.

* This name was adopted in 1853 by Leuckart (*Wieg. Archiv f. Naturg.* xix. p. 258) for a curious Macrurous Crustacean. I have, therefore, altered the termination, whilst retaining the allusion to the whip-like character of the anterior legs.

The two species known of this remarkable genus are both from the Asiatic Region, perhaps the richest in remarkable forms of all the great geographical areas.

MASTIGOCHIRUS GRACILIS. Pl. V. fig. 7.

Mastigopus gracilis, Stimpson, *Proc. Ac. Nat. Sci. Phil.* p. 244 (1858).

Carapace elongate-ovate, very convex, with short crenulated setose lines. Front 3-toothed; the median tooth triangular, the lateral slender, and longer than the median one. Antero-lateral margins 6-toothed, the teeth diminishing in length posteriorly. Eyes slender, and more than half as long as the antennules. Second joint of the maxillipedes oblong, longer than broad. Anterior legs greatly elongated, slender, cylindrical; the dactylus is longer than the carapace, and consists of 12-14 elongated joints; terminal joints of the legs of the second and third pairs very slightly falcate. Last segment of the postabdomen elongate, thick, longitudinally sulcate in the middle, and bicarinate near its base. Length about $\frac{1}{2}$ inch.

Hab. China Seas (*Stimpson, Coll. Brit. Mus.*).

The single example of this species in the national collection was presented by the Smithsonian Institution.

MASTIGOCHIRUS QUADRILOBATUS, sp. n. Pl. V. fig. 8.

Body elongate-ovate, very convex, marked with short crenulated setose lines, as in the preceding species. Front 4-lobed, the two median lobes small, rounded, and not nearly as prominent as the spiniform lateral lobes. The striated lateral area is reduced to a narrow line, bordering the whole length of the carapace, which is without lateral marginal teeth. Eyes long, slender, and half as long as the antennules; second joint of the maxillipedes broad, with the inner margin arcuate. Anterior legs very long, when thrown forward longer than the body; the terminal joint consists of ten or a dozen obscure unequal joints, and is clothed with long fulvous hairs; the terminal joints of the second and third pairs of legs are long, and very slightly falcate. The outer ramus of the appendages of the penultimate segment is about half as long as the inner. The terminal segment is oblong-lanceolate. Length of carapace 5 lines.

Hab. Philippine Islands, Guimaras (*Coll. Brit. Mus.*).

The form of the front, and the absence of antero-lateral marginal teeth, at once distinguish this species from the foregoing.

The single specimen in the Museum was purchased of H. Cuming, Esq.

HIPPA.

Hippa, *Fabr. (part.), Mantissa Ins.* i. p. 329 (1787); *M.-Edw. Hist. Nat. Crust.* ii. p. 207 (1837); *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Antennules of moderate length. Antennæ with a very long, robust, multiarticulate, and strongly ciliated flagellum. Third maxillipedes with the last joint narrow, laminate, and compressed. First legs with the last joint lamellate-oval.

The species of this genus, of which two inhabit the opposite shores of the American continent, and one the Indian and Indo-Malayan region, bear a very close resemblance to one another; but the distinctive characters, although slight, appear constant in large series of specimens.

HIPPA EMERITA. Pl. V. fig. 9.

? *Cancer emeritus*, *Linn. Syst. Nat.* (ed. 12) p. 1055 (1766).

? *Astacus emeritus*, *Fabr. Ent. Syst.* ii. p. 484 (1793).

Cancer testudinarius, *Herbst, Naturg. Krabben*, ii. p. 8, pl. xxii. fig. 3 (1796).

Hippa emeritus, *Fabr. Ent. Syst. Suppl.* p. 370 (1798).

Hippa emerita, *Latr. (?) Hist. Nat. Crust.* vi. p. 176 (1803); *Lamarck (?)*, *Hist. Anim. sans Vert.* v. p. 222 (1818); *Desmarest, Consid. Crust.* p. 174, pl. xxix. fig. 2 (1825); *M.-Edw. Hist. Nat. Crust.* ii. p. 209 (1837); *Crust. in Cuvier R. A.* (ed. 3) pl. xlii. fig. 2; *Gibbes, Proc. Amer. Assoc.* p. 188 (1850); *Dana, U.S. Expl. Exp.* xiii. *Crust.* i. p. 409, pl. xxv. fig. 9 (1852); *Guérin-Ménéville, Icon. R. A. Crust.* pl. xv. fig. 2; in *Ramon de la Sagra, Hist. Isla de Cuba*, vii. *Crust.* p. xxxiv. (1856); *Heller, Crust. in Reise der Novara*, p. 73 (1865).

Hippa talpoidea, *Say, Journ. Ac. Nat. Sci. Phil.* i. p. 160 (1817); *De Kay, Zool. New York Fauna*, pt. vi. p. 18, pl. vii. fig. 17 (1844); *Gibbes, Proc. Amer. Assoc.* p. 188 (1850); *Smith, Trans. Conn. Ac.* iii. p. 311 (1877).

Body very convex. Median lobe of the front *triangular, sub-acute*, and separated from the lateral lobes by a distance usually greater than its own breadth at base; the lateral frontal lobes are narrow, acute, and much more prominent than the median lobe. Carapace marked with irregular crenulated transverse lines, which are nearly obliterated on the sides and towards the posterior margin; and with a distinctly marked postfrontal and postgastric incised line. Eyes very long and slender. Antennules densely

hairy. Second joint of outer antennæ with three spines at its distal extremity, of which the median is very much the longest, *and directed slightly outward*; flagellum very long, robust, multi-annulated, and ciliated on its outer margin. Third joint of the outer maxillipedes with the lobe at its antero-internal angle triangular and subacute. Terminal joint of the first pair of legs ovate; those of the second and third pairs of legs falcate, very broad at base, narrow and subacute in their terminal halves. Rami of the appendages of the penultimate postabdominal segment short, the outer shorter and broader oval than the inner.

The length of the carapace of the largest specimen from Brazil is 1 inch 2 lines; but in a specimen of uncertain locality in the collection the carapace is nearly $1\frac{3}{4}$ inch long.

Hab. Brazil (*Mus. Paris, Brit.*); Rio Janeiro (*Dana, Heller, Coll. Brit. Mus.*); Five-Fathoms Bay (*Coll. Brit. Mus.*); Venezuela (*Coll. Brit. Mus.*); Martinique (*Herbst*); Cuba, Mexico (*Guérin-Ménéville*); United States (*Coll. Brit. Mus.*); Boston, New York, Charleston Harbour, Key West (*Gibbes*).

Specimens from Mazatlan, referred to this species by De Saussure, belong in all probability to *H. analoga*. I think there can be little doubt that *H. talpoidea*, Say, is identical with the Brazilian *H. emerita*, although Gibbes, founding his conclusions upon a comparison of four specimens from Carolina with two from Brazil, is of the opposite opinion. The specimens from the United States in the British Museum, presented by Say, are small, and scarcely suffice to determine the question, but certainly do not appear specifically distinct.

According to De Kay (*l. c.*) and Smith (*Trans. Conn. Ac.* iii. p. 111, 1877), *H. talpoidea* inhabits the entire eastern coast of the United States from Cape Cod southward to the west coast of Florida, Egmont Key being the most southern and western habitat known to the latter author.

It is impossible to say to what species belong the specimens from the Sandwich Islands referred by Randall to *H. emerita*, as no description accompanies them.

HIPPA ANALOGA. Pl. V. fig. 10.

Hippa emerita, M.-Edw. & Lucas, *Crust. in D'Orbigny's Voy. Amér. mérid.* vi. p. 32 (1843); Nicolet, *Crust. in Gay, Hist. Chile*, iii. p. 185 (1849); De Saussure, *Rev. et Mag. Zool.* v. p. 367 (1853), nec Edwards.

Hippa talpoides, Dana, *Crust. in U.S. Expl. Exp.* xiii. 1, p. 409, pl. xxv. fig. 10 (1852); *Proc. Ac. Nat. Sci. Phil.* vii. p. 175 (1854), nec Say.
Hippa analoga, Stimpson, *Proc. Boston, Soc. Nat. Hist.* vi. p. 85 (1856-59); *Journ. Bost. Soc. Nat. Hist.* vi. p. 486 (1857).

This species is nearly allied to *H. emerita*; but the carapace is generally more rugose anteriorly, and the posterior margin is straight. *The median frontal lobe is broader, less acute, and not separated so widely from the lateral lobes*, which are acute but far less prominent. The median spine of the second joint of the antennæ is proportionally not so long, *and is directed slightly inward* (not outward, as in *H. emerita*). The lobe of the antero-internal angle of the third joint of the outer maxillipedes, in the specimens I have examined, is broader, more rounded, and less prominent. Length of the carapace of the largest specimen about 1 inch 2 lines.

Hab. Chili, Valparaiso (*M.-Edw. & Lucas, Dana*); Chiloe, Ancud, Luco Bay, and San Vincente (*Cunningham, Coll. Brit. Mus.*); Mexico (*Coll. Brit. Mus.*); Mazatlan (*Saussure*); California, Tomales Bay (*Stimpson*); San Francisco and Monterey (*Stimpson, Coll. Brit. Mus.*).

There are in the British-Museum collection two specimens obtained by purchase, and labelled as having been obtained, with a number of other Crustacea, from "New Zealand and New Holland." They are of small size; carapace about 7 lines in length, and appear to belong to *Hippa analoga*, the form of the frontal lobes and second joint of the antennæ being the same. There may be some mistake in regard to their habitat.

HIPPA ASIATICA. Pl. V. fig. 11.

Hippa asiatica, Milne-Edwards, *Hist. Nat. Crust.* ii. p. 209 (1837);
Heller, Reise der Novara, Crust. p. 73 (1865).

The specimens which I refer to this species are very nearly allied to the two preceding, but differ from them in the following particulars:—The body is very convex and narrow, appearing almost cylindrical when viewed from above. The lobes of the front are very narrow and acute, the median is separated by an interval of nearly twice its own breadth from the lateral ones, which do not project much beyond it. The median spine of the second joint of the antennæ is very long, and bent very slightly inward. The antero-internal lobe of the third joint of the maxillipedes is broad, rounded, and but little prominent. The terminal joint of the

first pair of legs is acute, and terminates almost in a spine. Length of carapace of largest specimen, 1 inch 2 lines.

Hab. Seas of Asia (*Mus. Paris*); Ceylon (*Heller, Mus. Brit.*); Madras (*Heller*); India, Java (*Mus. Brit.*).

Fam. ALBUNEIDÆ.

Albunidæ, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Anterior legs terminating in a more or less perfectly subchelate hand. Third maxillipedes subpediform (the third joint not greatly enlarged), and furnished with an exognath. Last tail-segment not greatly elongated, ovate-lamellate.

ALBUNEA.

Albunea, *Fabr. Ent. Syst. Suppl.* pp. 372, 397 (1798); *M.-Edw. Hist. Nat. Crust.* ii. p. 202 (1837).

Albunæa, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Eye-peduncles lamellate compressed; cornea very small. Antennules with an extremely long multiarticulate flagellum. Second joint of antennæ with a narrow but well-developed accessory joint; flagellum very short. Third maxillipedes with the third joint but slightly enlarged, and the fourth joint but shortly produced at its antero-external angle.

ALBUNEA SYMNISTA.

Cancer symnista, *Linn. Syst. Nat.* p. 1053 (1766).

Hippa symnista, *Fabr. Ent. Syst.* ii. p. 474 (1793).

Cancer dorsipes, *Herbst, Naturg. Krabben u. Krebse*, ii. p. 5, pl. xxii. fig. 2 (1796), nec *Linn.*

Albunea symnista, *Fabr. Ent. Syst. Suppl.* p. 397 (1798); *Latr. Hist. Crust.* vi. p. 172 (1803); *Lamarck, Hist. Anim. sans Vert.* v. p. 224 (1818); *Desmarest, Consid. Crust.* p. 173, pl. xxix. fig. 3 (1825); *M.-Edwards, in Cuvier's Règne Animal* (ed. 3), *Crust.* pl. xlii. fig. 3; *Hist. Nat. Crust.* ii. p. 203 (1837); *Guérin-Ménéville, Icon. Règne Anim. Crust.* pl. xv. fig. 1; *Heller, Crust. in Voy. Novara*, p. 72 (1865).

Moderately convex, shining; carapace marked with transverse interrupted impressed lines, of which the postfrontal and the angulated line separating the gastric from the branchial region are the most distinct. Anterior margin with 12-14 closely placed spiniform teeth, a semicircular median emargination, and a small median tooth. Antero-lateral angles of the carapace with a small acute spine. Eye-peduncles about twice as long as broad at base, with their outer margins arcuated; the cornea minute. Antennæ not longer than the carapace, very hairy; basal joint with

a spine at its antero-external angle; flagellum with the joints diminishing successively in size. Antennules very long, exceeding the body in length; the flagellum multiarticulate, and fringed with long hairs on its upper and inner margin. Anterior legs with the hand very short, and high in proportion to its length, with short interrupted and setose ridges on its outer surface; its anterior margin straight, with a short spine at the antero-inferior angle; finger arcuate, acute. Terminal joint of second pair of legs strongly falcate, the distal half rather sharply bent; that of the *third pair slender, arcuate, with a prominent and narrow lobe near its proximal end*; that of the fourth pair broad, slightly falcate, and acute at its distal extremity. Terminal joint of the postabdomen longer than broad, spatulate, ovate, not narrowed and produced at its distal extremity. Length of carapace about 1 inch.

Hab. India, Pondicherry (*Coll. Brit. Mus.*); seas of Asia (*Coll. Mus. Paris*); East Indies, Amboina (*Herbst*); Nicobars, Madras (*Heller*).

Albunea symnista, Fabr., is mentioned by Brullé in his list of the Crustacea inhabiting the Canaries, given in Webb and Berthelot's *Hist. Nat. des îles Canaries*, ii. Zool. Crust. p. 17; but this may prove on comparison to be one of the species inhabiting the Mediterranean or Eastern American coast.

In the males of this species the terminal segment is notched at its base, where it is articulated with the penultimate, and attains its greatest width near its broadly rounded distal extremity, toward which it is suddenly narrowed. In the females this segment is narrow-ovate (see Lucas, *Rev. et Mag. Zool.* v. p. 47, pl. i. fig. 8, a, b).

The form of the eye-peduncles, with the number of teeth on the anterior margin of the carapace, and the form of the terminal joint of the third pair of legs, suffice to distinguish *A. symnista* from its congeners.

ALBUNEA GUERINII*.

Albunea symnista, Lucas, *Crust. in Explor. Algérie*, p. 27, pl. iii. fig. 2 (1849); *Heller, Crust. südl. Europa*, p. 153 (1863).

* It is possible that this is the species described by Linnæus (*Syst. Nat.* p. 1052) from the Mediterranean, under the name of *Cancer carabus*. By "*Rostrum dentibus 2 parallelis mobilibus depressis*," the eye-peduncles may be meant. The remainder of the description would apply fairly well to a species of the genus *Albunea*.

Albunea guerinii, Lucas, *Rev. et Mag. Zool.* (sér. 2) v. p. 47, pl. i. fig. 9 (1853).

This species, according to M. Lucas, differs from *Albunea symnista* (with which species he confounded it in the *Explor. Algérie*, i. p. 27, pl. iii. fig. 2) in the shorter and narrower ocular peduncles, less elongated and crowded frontal spines, which are broader at base, and in the form of the terminal segment of the postabdomen, which is altogether cordiform in the male, broader and ovate in the female. Length of the male 30–33 millims. (1 inch 2–3½ lines); of female 40 millims. (nearly 1 inch 7 lines).

Hab. Gulf of Algiers (*Lucas*).

As compared with *A. symnista*, M. Lucas has shown (*l. c.* fig. 9, *a*, *b*) that the terminal segment is scarcely notched, and attains its greatest width nearer the base than the distal extremity, which is represented as more acute than in that species. In the female the terminal segment in *A. guerinii* is more broadly ovate.

No explanation of the figures accompanies the description of this species; but if, as appears certain, the figure 9*b* represents the tarsus of the third pair of legs, a comparison of it with the same joint of *A. symnista* figured on the same plate (fig. 8*d*) reveals another very marked distinction between the two species. In *A. symnista*, as stated above, the terminal joint has a prominent narrow linear lobe near its articulation with the preceding joint. In *A. guerinii* this lobe is *almost obsolete*, scarcely indicated by an obscure tubercle.

ALBUNEA MICROPS, sp. n. Pl. V. figs. 12, 13.

Albunea microps, White, *List Crust. Brit. Mus., Append.* p. 129 (1847), *descript. nulla*.

In this species the carapace is somewhat broad and depressed, with nine teeth on its anterior margin; the eye-peduncles are even broader and shorter than in *A. symnista*, being not twice as long as broad at the base; and the cornea is borne on a small tuberculiform lobe or prominence. The terminal joint of the third pair of legs is slightly broader, but not lobate at its proximal end. The last segment of the postabdomen of the male is nowhere as broad as that of *A. symnista*, and is narrowed to its rounded distal extremity. Length of carapace a little over ½ inch.

Haab. Sooloo Island (*Coll. Brit. Mus.*).

A single specimen is in the collection.

The rami of the appendages of the sixth segment are arcuate,

the inner longer and much narrower than the outer. The terminal segment is membranaceous in its distal half, and the lateral margins are inflexed. The transverse interrupted ridges on the carapace are very distinctly marked, giving the animal a rugose appearance.

ALBUNEA GIBBESII.

Albunea symnista, *Gibbes*, *Proc. Amer. Assoc.* p. 187 (1850).

Albunea gibbesii, *Stimpson*, *Ann. Lyc. Nat. Hist. New York*, vii. p. 78, pl. i. fig. 6 (1862).

This species bears a general resemblance to *A. symnista*; but the carapace is much broader in proportion to its length. There are but six or eight teeth on the anterior margin of the carapace. The ocular peduncles are narrower in proportion to their length, and their outer margin is straight. The last joint of the second pair of legs has a broadly triangular, not a narrow and prominent lobe near its proximal end; that of the third pair is broader than in *A. symnista*. The inner ramus of the penultimate pair of post-abdominal appendages is much broader and nearly as long as the inner; and its terminal joint in the male is somewhat oblong, *with a narrow prolongation at its distal extremity*.

Hab. Florida, St. Augustine and among the Keys (*Stimpson*); Charleston Harbour (*Gibbes*); south-eastern coast, United States (*Coll. Brit. Mus.*).

The single specimen of this species in the British-Museum collection is a male. The form of the terminal segment in the female is not stated; that of the same segment in the male serves to distinguish the species from all its congeners. The length of the carapace a little exceeds 1 inch.

ALBUNEA OXYOPHTHALMA. Pl. V. figs. 14, 15.

Albunea oxyophthalmus, *Leach* (MS.); *White*, *List Crust. Brit. Mus.* p. 57 (1847), sine descr.

This species is nearly allied to *A. symnista*, but differs as follows:—The eye-peduncles are very long, narrow, more than three times as long as broad at the base, with their outer margins straight. There are ten to twelve teeth on the anterior margin of the carapace, on each side of the median notch. The lobe at the proximal end of the last joint of the third pair of legs is prominent, triangular, and acute, but not so narrow at base as in *A. symnista*. The terminal segment of the postabdomen in the male is scarcely longer than broad, broadest in the middle, nearly

straight at its proximal extremity; that of the female is longer than broad, oblong-ovate. Length of carapace of largest specimen about $1\frac{1}{3}$ in.

Hab. West Indies, St. Christopher's; Cayenne; Brazil (*Coll. Brit. Mus.*).

In this species, as in all the preceding, the spine at the anterolateral angle of the carapace is of moderate length, not reaching beyond the level of the anterior margin of the carapace, and the median semicircular emargination of the front about twice as wide as deep.

Albunea paretii, Guérin-Méneville, *Rev. et Mag. Zool. sér. 2, v. p. 48, pl. i. fig. 10* (1853), may not improbably belong to this species. The type specimen was, as its author states, given to him by the Marquis Pareto with some Crustacea obtained in the neighbourhood of Genoa; but he had also received other Crustacea from America from the captain of a merchant vessel, and consequently was unable to speak positively as to the habitat of the species. It differs from *A. symnista* and *A. guerinii* principally in its elongated and very narrow eye-peduncles (which are represented as even longer and narrower at base than are those of *A. oxyophthalma*), subelongate and less crowded frontal spines, and narrower terminal postabdominal segment. The uncertainty of the habitat and brevity of the description render it impossible to determine its position with certainty, without an examination of the typical specimen.

ALBUNEA LUCASII.

Albunea lucasia, *Saussure, Rev. et Mag. Zool. v. p. 367, pl. xii. fig. 4* (1853).

Albunea lucasii, *Stimpson, Journ. Bost. Soc. Nat. Hist. vi. p. 485* (1857).

This species is characterized by De Saussure as having a very deep median frontal emargination, styliform ocular peduncles, and a very long spine on each side of the carapace. Length of carapace about 1 inch.

Hab. Mazatlan (*De Saussure*).

This species, in the form of the eye-peduncles, very nearly resembles the preceding; but the differences instanced by De Saussure appear sufficient to warrant its specific separation, if regard be had to its recorded habitat being on the western, not the eastern, coast of the American continent. In De Saussure's figure of the carapace, the frontal margin is represented as 8-10-

toothed, the median frontal notch not wider than deep, and the spine at the antero-lateral angle much longer than in *A. oxyophthalma*. The anterior legs were wanting; and nothing is said of the form of the tarsal joints of the remaining legs, or of the form of the terminal segment, by De Saussure.

ALBUNEA SPECIOSA.

Albunea speciosa, Dana, *U.S. Expl. Exp.* xiii. *Crust.* i. p. 405, pl. xxv. fig. 6 (1852).

This species is characterized by Dana as having the carapace marked with transverse lines, anterior margin either side of middle about 10-toothed, sides of thorax nearly parallel; peduncles of eyes slender, attenuate; anterior or upper margin of last joint of fourth pair of legs nearly straight; terminal segment a little oblong, quite entire, at apex subtriangular, its sides nearly parallel, sparingly arcuate. Length of carapace $7\frac{1}{2}$ lines.

Hab. Sandwich Islands (*Dana*).

This species appears to be well characterized by the form of the eye-peduncles, which are represented in the figure as much narrower in their distal than in their proximal half; *concave, not convex or straight, on their outer margins*. The spine at the antero-lateral angle is very small, and does not reach to the anterior margin of the carapace. The form of the tarsal joint of the third pair of legs is not mentioned; that of the fourth pair is broad and scarcely at all falcate. The terminal segment (apparently of the female) is oblong-ovate. I have seen no specimens of this species.

LEPIDOPS*.

Lepidopa, Stimpson, *Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Eye-peduncles lamellate, compressed, almost squamiform, cornea not visible. Antennules long. Antennæ with a very small accessory joint, flagellum very short. Third maxillipedes with the fourth joint produced at its antero-external angle into a lobe, which reaches to or beyond the distal extremity of the fifth (penultimate) joint.

By the opposition of the last two joints of the third maxillipedes to the lobe of the antepenultimate joint, a prehensile organ is developed similar to that formed in the same pair of limbs in

* The generic name *Lepidopa* is more correctly written *Lepidops* by Stimpson in his description of *L. myops*.

certain Amphipoda (e.g. *Cerapus*), except that in the Amphipoda the antepenultimate joint is produced at its antero-inferior angle.

The species are all from America.

LEPIDOPS SCUTELLATA.

Albunea scutellata, *Desm. Consid. Crust.* p. 173 (1825); *M.-Edw. Hist. Nat. Crust.* ii. p. 204, pl. xxi. figs. 9-13 (1837); *Gibbes, Proc. Amer. Assoc.* p. 187 (1850); *Dana, U.S. Expl. Exp.* xiii. *Crust.* i. p. 406 (1852).

Lepidopa scutellata, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858); *Ann. Lyc. Nat. Hist. New York*, vii. p. 79 (1862).

Carapace scarcely emarginate, and without any noteworthy denticles or spines on its anterior margin. Eye-peduncles much broader than long, and truncate anteriorly. Length of carapace 7 lines.

Hab. Peru, San Lorenzo? (*Dana*); Island of St. Thomas (*A. H. Riise*).

No locality is mentioned by Desmarest* or Milne-Edwards for this species. Dana observes of the specimens collected at San Lorenzo that the proportions are different from those in the figure by Edwards. The hand is very thin and high, the height being equal to the length; the lower margin is slightly arcuate, and not at all deflexed at the base of the immobile finger; this finger is acute and short, the margin above it vertical and hairy. The front margin has a low median point, and also another equally advanced, halfway to the side, with the margin between sinuous. It is not improbable that the specimens from St. Thomas and San Lorenzo may prove upon comparison to belong to distinct species. Length of carapace of female 6 lines. I have seen no specimens.

LEPIDOPS VENUSTA.

Lepidopa venusta, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858, sine descr.); *Ann. Lyc. Nat. Hist. New York*, vii. p. 79 (1862).

Carapace glabrous, of a silvery hue, with bluish reflections (in specimens preserved in spirits). The markings of the dorsal surface of the carapace are less profound and less numerous than in *L. scutellata*; and the principal transverse sulcus is nearly straight and not undulated as in that species. Front tridentate; lateral teeth situated at about halfway between the median one and the lateral angles, and consequently nearer the median one

* Desmarest considered his specimens to be the *Hippa* (*Albunea*) *scutellata* of Fabricius; but see above, under *Remipes scutellatus*.

than in *L. scutellata*. Eye-peduncles large, oval, diverging, and a little thickened below the middle, the minute eye being situated on the inferior surface near the extremity. Antennules slender, with flagella more than five times as long as the carapace. Feet nearly as in *L. scutellata*; but the dactylus of the second pair is more sharply excised, and the dactyli of the following pairs are more slender.

Hab. St. Thomas (*Stimpson*). I have seen no specimens of this species.

LEPIDOPS MYOPS. Pl. V. fig. 16.

Lepidops myops, *Stimpson*, *Ann. Lyc. Nat. Hist. New York*, vii. p. 241 (1862).

Carapace with the same markings on the surface as in *L. scutellata*, but stronger. Postfrontal transverse groove broad, with granulated surface. Median lobe of front rounded; margin armed with small teeth like those of a comb, which become more conspicuous outwardly as far as the lateral lobes, where the margin becomes smooth. Eye-peduncles or scales obliquely oblong, rather thick, broader behind, antero-lateral angle prominent, subacute; inner angle rounded; eye-specks obsolete in most of the specimens, in others barely visible on the inferior side of the ocular plate, near the exterior angle. In other characters this species approaches very near to *L. scutellata*.

Hab. Cape St. Lucas (*Stimpson*, *Coll. Brit. Mus.*).

Two specimens (a male and a female) are in the British-Museum collection, from the Smithsonian Institution. The fifth segment in both sexes has slender lateral lobes or wings. The terminal segment in the male is triangular, broad, and rounded on the sides at its proximal and acute at its distal extremity; that of the female is ovate-triangular, more rounded and obtuse at its distal extremity. They are both of small size. Length of carapace about 5 lines.

BLEPHAROPODA.

Blepharipoda, *Randall*, *Journ. Ac. Nat. Sci. Phil.* viii. p. 130 (1839);

Stimpson, *Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Albunhippa, *M.-Edw. & Lucas*, *Arch. Mus. Hist. Nat.* ii. p. 477 (1841).

Abrote, *Philippi*, *Arch. f. Naturg.* xxiii. p. 124 (1857).

Eye-peduncles very slender, elongated, cylindrical, and articulated in the middle. Antennules and antennæ rather long, and with a multiarticulate flagellum; antennæ without an accessory joint.

Third maxillipedes with the third joint narrow and similar to the fourth, which is not produced at its antero-external angle.

It is possible that the three species of this genus belong in reality to one and the same form; but as I have not the material on which to base an accurate comparison, it may be advisable to consider them for the present as distinct. All are from the western American coast.

BLEPHAROPODA OCCIDENTALIS.

Blepharipoda occidentalis, *Randall, Journ. Ac. Nat. Sci. Phil.* viii. p. 131, pl. vi. (1839); *Gibbes, Proc. Amer. Assoc.* p. 187 (1850); *Stimpson, Journ. Bost. Soc. Nat. Hist.* vi. p. 486 (1857).

Carapace convex, somewhat obliquely elevated toward the centre, which is faintly carinate; a median transverse sinuous impression, behind which the surface is polished, but anterior to it densely marked with small transverse impressions, most of which are pectinate and hairy; a lateral transverse impression and a very profound oblique one connected with it inferiorly; frontal edge strongly 3-toothed, and excavated between the teeth; a distinct postfrontal transverse groove, behind which is a strong tooth; antero-lateral margin of the carapace with four stout teeth on each side, posterior margin excavated: second, third, and fourth pairs of feet more or less roughened laterally, and with the anterior edge minutely dentate; anterior pair stout; arm with a strong tooth near its anterior inferior extremity; carpus elongate, rather convex, laterally impressed, and having on its upper anterior edge a great spiniform crest, which is itself bordered with smaller spines; hand flattened on the side, and armed with two or three strong sharp teeth, having between them a great multitude of impressions similar to those of the carapace; pincers flattened, acute at tip, and armed with sharp spiniform teeth both on their outer edges and on their prehensile side. Length about 2 inches.

Hab. California, San Diego (*Randall, Stimpson*); Monterey (*Coll. Brit. Mus.*).

The above is *Randall's* description.

There is in the collection of the British Museum a very much mutilated specimen of this species, gummed in detached fragments on cardboard, from Monterey, California, the imperfect condition of which precludes the possibility of description. It may be noted, however, that the anterior margin of the palm and the outer margin of the mobile finger are armed with a series of four spines, which decrease in size toward the articulation and are

none of them very large. In a second (female) specimen of unknown locality which is in the collection, and appears to belong to this species, the number of spines varies from three to four. The terminal segment is almost orbiculate in outline.

BLEPHAROPODA SPINIMANA.

Abrote spinimana, *Philippi, Archiv f. Naturg.* xxiii. p. 129, pl. viii. (1857).

Blepharipoda spinimana, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Carapace elongate-ovate and convex above. Front 3-toothed, the teeth triangular, and ending in long spines, the median tooth rather less prominent than the lateral. There is a small median spine immediately behind the groove defining the anterior margin of the gastric region, and four spines on the antero-lateral margins, of which the first is long and the last very small. The eye-peduncles are very slender; and their penultimate about equals the last joint in length. The flagella of the antennæ have a series of long hairs. The anterior legs have the arm short, with a long spine on its inferior margin; wrist with a strong triangular tooth on the upper margin at the distal extremity, behind which is a spine; palm slightly rugose externally, with two spines on its outer surface, one on its inferior margin at its infero-distal angle, and two very strong spines on its anterior margin and on the upper margin of the mobile finger. Terminal joints of the second and third legs strongly falcate, those of the second pair broader and shorter than those of the third pair, those of the fourth pair but slightly falcate, the fifth pair slender, small, and monodactyle. Tail-segments (the last excepted) short, with horizontal ovate lateral lobes; the last joint of the male is twice as broad as the foregoing at the base, as broad as long, with the sides converging to the distal extremity.

Hab. Chili, at Tomé, in Bay of Talcahueno (*Philippi*); Bay of Valparaiso (*Coll. Brit. Mus.*).

The specimens described by *Philippi* were found by Herr Ph. Germain on the sea-shore. The specimen (a male) in the British-Museum collection was found by fishermen in deep water in the Bay of Valparaiso, where it is stated to be of rare occurrence. The length of its carapace is nearly 1 in. 2 lines.

BLEPHAROPODA SPINOSA.

Albunhippa spinosa, *M.-Edw. & Lucas, Arch. Mus. Hist. Nat.* ii. p. 477,

pl. xxviii. figs. 1-13 (1841); *Dana, U.S. Expl. Exp.* xiii. *Crust.* i. p. 406 (1850).

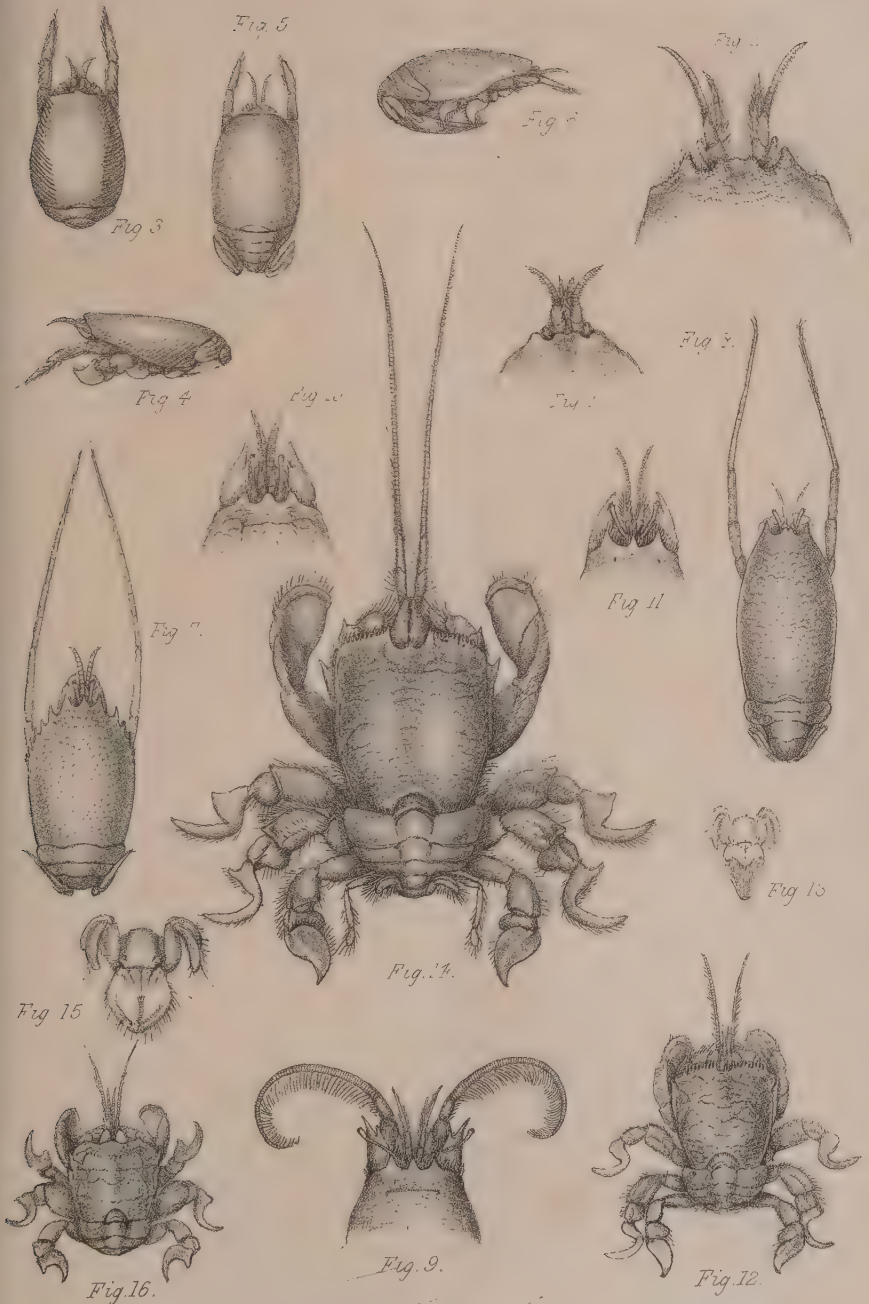
Blepharipoda spinosa, *Stimpson, Proc. Ac. Nat. Sci. Phil.* p. 230 (1858).

Hab. Peru, San Lorenzo (*Dana*).

The locality whence the specimen described by Milne-Edwards and Lucas was obtained is not stated; and there is nothing in their description to distinguish it from either of the foregoing species. The hands are represented in the figure as devoid of spines, but are described as spinose. *Dana* gives no particulars which would serve to characterize the specimens collected by the U.S. Exploring Expedition.

EXPLANATION OF PLATE V.

- Fig. 1. Front of *Remipes testudinarius*, nat. size.
 2. " " " var. *denticulatifrons*, also nat. size.
 3. *Remipes strigillatus*, Stimpson, nat. size.
 4. The same, lateral view.
 5. *R. truncatifrons*, n. sp., nat. size.
 6. The same, lateral view.
 7. *Mastigochirus gracilis*, Stimpson, $\times 2$ diam.
 8. *M. quadrilobatus*, n. sp., $\times 2$ diam.
 9. Front of *Hippa emerita*, Latr., nat. size.
 10. " " *analoga*, Stimpson, nat. size.
 11. " " *asiatica*, M.-Edw., nat. size.
 12. *Albunea microps*, White, MS., nat. size.
 13. " " " abdomen of male, $\times 2$ diam.
 14. *A. oxyophthalma*, Leach, nat. size.
 15. " " " abdomen of male, $\times 2$ diam.
 16. *Lepidops myops*, Stimpson, nat. size.
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CRUSTACEA CUMACEA

OF THE

‘LIGHTNING,’ ‘PORCUPINE,’ AND ‘VALOROUS’
EXPEDITIONS.

BY

THE REV. A. M. NORMAN, M.A.

Order CUMACEA.

Genus DIASTYLIS, Say, 1817.

(=*Alauna*, Goodsir, 1843.)1. *Diastylis Rathkii* (Kröyer).

1841. *Cuma Rathkii*, Kröyer, Naturhist. Tidsskrift, vol. iii. p. 513, pl. v. figs. 17-30; id. *op. cit.* anden rækkes ii. 1846, p. 144, pl. i. figs. 4, 5; id. *Voyages en Scandinavie &c.* pl. v. fig. 1, *a-u*.
 1852. *Cuma Rathkii*, Lilljeborg, Øfversigt af Vet.-Akad. Förhandl. p. 6.
 1856. *Diastylis Rathkii*, Bate, Ann. & Mag. Nat. Hist. 2nd ser. xvii. p. 451, pl. xiii.
 1859. *Diastylis Rathkii*, Danielssen, Beretning om en Zoologisk Reise foretag. Som. 1857, p. 7.
 1864. *Diastylis Rathkii*, G. O. Sars, Om Cumacea, Chr. Vid.-Selskab. Förhandl. 1864, p. 35, and 1873, Om Cumaceen fra de store dybder i Nordishafvet, Kongl. Vet.-Akad. Handl. Bd. ii. no. 6, p. 7, pl. iii. figs. 8, 9.

'Lightning' Expedition, Station 3, lat. 60° 31' N., long. 9° 18' W., 229 fathoms. 'Valorous' Expedition, Station 4, Davis Strait, lat. 66° 59' N., long. 55° 27' W., 60 fathoms.

This polar species is widely distributed in the Arctic and Boreal North Atlantic. I have seen it from Greenland, river St. Lawrence, N.E. America (New-England coast), Norway, Sweden, and Great Britain.

Professor G. O. Sars has, I think, fallen into error* in supposing that *Cuma angulata* of Kröyer is the male of his *C. Rathkii*. Both sexes of *D. Rathkii* are alike in the spiny armament of the carapace, consisting of two longitudinal lines of spines, one on each side of the dorsal line; these spines are largest and widest apart just behind the rostrum, where the spines are also usually in pairs on each line; the two lines gradually converge backwards, the spines rapidly decreasing in size, so as entirely to disappear at some distance from the hinder margin of the carapace. Among a collection of N.E. American Cumacea, for which I am indebted to Mr. L. I. Smith, is a *Diastylis* which I take to be the true *Cuma angulata* of Kröyer.

* Beskrivelse af de paa Fregatten Josephines expedition fundne Cumaceer, 1871, pp. 5 and 21.

2. *Diastylis cornuta* (Boeck).

1853. *Cuma bispinosa*, Stimpson, Marine Invertebrata of Grand Manan, p. 39.
 1860. *Cuma cornuta*, A. Boeck, Vidensk. Selsk. Förhandl. p. 190.
 1864. *Diastylis bispinosa*, G. O. Sars, Om Cumacea, p. 89.
 1865. *Diastylis bicornis*, Bate, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 84, pl. i. fig. 2.
 1868. *Diastylis bispinosa*, Norman, Brit. Assoc. Report, 1868 (1869), p. 270.

I am not satisfied that this is the *Cuma bispinosa* of Stimpson, though it is the species which has been known by that name among European carcinologists. I am not aware that the form for which I here adopt Boeck's name has been recorded from the American coast; and specimens of a New-England *Diastylis* are before me which seem to agree more nearly with Stimpson's brief description.

Sars says that the male of this *Diastylis* has a spineless carapace; but I have males which closely agree in the spiny armature of the carapace with the females; these are not, however, fully developed, inasmuch as the lower antennæ and uropods have not attained their plumose characters. It is hardly likely, however, that the subsequent exuviation, in which a change in *degree* of development would take place in these organs, would result also in so great a change in *kind* as from a strongly spinous to a smooth carapace. *Fully developed* males of *Diastylis* are scarce—that is, males in which the antennæ have attained their excessive length and the verticillately ciliated peduncle, and the abdominal feet have their swimming setæ on the peduncles. *Such* males I have seen of only a few species that I could assign to their females; they are more commonly taken in the tow-net than at the bottom, where, from their great activity, they probably generally succeed in escaping the dredge.

Diastylis cornuta was taken in the 'Porcupine' Expedition, 1869, in Lough Foyle, in 15 fathoms, and at Station 21, lat. 55° 40' N., long. 12° 46' W., in 1476 fathoms.

3. *Diastylis insignis*, G. O. Sars.

1871. *Diastylis insignis*, G. O. Sars, Œfvers. af Kongl. Vet.-Akad. Förhandl. p. 76; id. Beskrivelse af de paa Fregatten Josephines expedition fundne Cumaceer, Kongl. Svenska Vetensk.-Akad. Handl. ix. p. 34, pl. xiv. figs. 68-71.

A strongly marked and beautiful species, described by Sars from the 'Josephine' Expedition, having been taken on a muddy bottom in 550 fathoms off the coast of Portugal. A single specimen was dredged in the 1869 'Porcupine' Expe-

dition, in 250 fathoms, to the west of Shetland, lat. $60^{\circ} 45'$ N., long. $3^{\circ} 6'$ W.

4. *Diastylis echinata*, Bate.

1865. *Diastylis echinata*, Bate, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 81, pl. i. fig. 1.

The type specimen was dredged off Shetland; and Sars has taken it in 100–300 fathoms on the coast of Norway (Hardanger and Christiania Fiords and Lofoten Islands).

In 1868 it was dredged by the 'Lightning' Expedition, Station 8, lat. $60^{\circ} 10'$ N., long. $5^{\circ} 59'$ W., in 550 fathoms.

5. *Diastylis Josephinæ*, G. O. Sars.

1871. *Diastylis Josephinæ*, Öfvers. af Kongl. Vet.-Akad. Förhandl. p. 77; id. 'Josephines' Cumaceer, Kongl. Svenska Vetensk.-Akad. Handl. ix. p. 36, pl. xv. figs. 72–74.

The types of this *Diastylis* were dredged in 750 fathoms off the Portuguese coast (lat. $38^{\circ} 10'$ N., long. $9^{\circ} 25'$ W.), in the 'Josephine' Expedition. It seems to be the commonest Cumacean inhabiting the deep waters between Farøe and Shetland.

	Station.	Lat.	Long.	fms.
'Lightning,' 1868.	6	$67^{\circ} 7'$ N.	$5^{\circ} 21'$ W.	500
'Porcupine,' 1869.	36	48 50	11 9	725
" " .	47a	59 34	7 18	542
" " .	75	60 45	3 6	344
" " .	90	59 41	7 34	458

6. *Diastylis polaris*, G. O. Sars.

1873. *Diastylis polaris*, G. O. Sars, Om Cumaceer fra de store dybder i Nordishavet, Kongl. Svenska Vetensk.-Akad. Handlingar, xi. no. 6, p. 4, pl. i. figs. 1–3.

Cephalothorax, viewed laterally, elongated ovate, greatest depth subcentral. *Carapace* longer than free cephalothoracic segments, having two indistinct obliquely transverse rugæ on the hinder portion, rough all over with microscopic spines of subequal size, and pitted all over, the pittings being more conspicuous on the portion posterior to the rugæ, where also the microscopic spines are fewer in number; lateral margin denticulately serrated on the anterior half; posterior margin elevated into a well-pronounced fillet. Second, third, and last cephalothoracic segments denticulate on their anterior margin; last segment with the epimera not produced. *Telson* not quite equal in length to two preceding segments, subequal to peduncle of uropod, with 9–11 small spines on each side. *Uropods* slender; peduncle subequal to telson, with 12–

14 spines on inner margin; inner ramus with first joint furnished with five, second with two, third with three lateral and a terminal spine; outer ramus longer than inner, with 4-5 setæ on external margin. Length 8-10 millims.

At first sight near to *D. lævis*; but the carapace, instead of being conspicuously setose as in that species, is rough with microscopic spines, the small and uniform size of which suffices to distinguish it from the spine-ornamented species with which we are acquainted, except *D. stygia*, G. O. Sars, which has not the rugæ of *D. polaris*. Sars speaks of the rugæ as one or three in number; in the above description, which was drawn up before the species was described in Norway, it will be seen I mention two.

Habitat. 'Lightning,' 1868, Station 3, lat. 60° 31' N., long. 9° 18' W., 229 fathoms. The type specimens were dredged by the Swedish Expedition in the Arctic Seas, lat. 80°, long. 4° 33' E., in 950 fathoms.

7. *Diastylis biplicata*, G. O. Sars.

1864. *Diastylis biplicata*, G. O. Sars, Om Cumacea, p. 46.

This species has a great range in depth. The types were taken by Sars in 20-30 fathoms, off the Lofoten Islands; and I have specimens dredged off the Durham coast in a few fathoms; but in the 'Porcupine' Expedition of 1869 it occurred down to 1630 fathoms. The localities in that expedition are:—

	Lat.	Long.	fms.
Station 2 . . .	51° 22' N.	12° 25' W.	808
„ 11 . . .	53 24	15 24	1630
„ 17 . . .	54 28	11 44	1230
„ 18 . . .	54 15	11 9	183

8. *Diastylis spinosa*, Norman.

1868. *Diastylis spinosa*, Norman, Brit. Assoc. Report, p. 271.

1878. *D. bimarginatus*, Bate, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 409.

1878. *D. bimarginatus*, Sim, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. p. 453, pl. xviii. figs. 3-5.

A single specimen was taken, 'Porcupine' 1869, in each of the following localities:—

	Lat.	Long.	fms.
Station 6 . . .	52° 25' N.	11° 40' W.	90
„ 18 . . .	54 15	11 9	183

The type was from Shetland; and I have also procured the

species in deep water off Valentia, Ireland, while Mr. Bate has recorded it from Aberdeen.

Only the male is known to me. It would be more satisfactory if we could pair it; but the two sexes of such species as might be supposed to be most nearly allied to *D. spinosa* are known; and we conclude, therefore, that the female, up to the present time, has hidden herself.

9. *Diastylis longipes*, G. O. Sars.

1871. *Diastylis longipes*, G. O. Sars, Beskr. af de paa Fregatte Josephines Exped. fundne Cumaceer, p. 32, pl. xiii. figs. 65-67.

At once known by three very remarkable characters:—

1. The extraordinary length of the first pair of feet, which had led me to apply the very same name in my MS. to the species as that which Sars has given it.

2. The crest of spines on the underside of the first abdominal segment.

3. The peculiar and unique appearance of the large telson, which is devoid of the usual lateral spines throughout almost its entire length, and has only a few minute spines close to the origin of the terminal fork.

Sars records it from lat. 38° 7' N., long. 9° 18' W., 'Josephine' Expedition, 550 fathoms; and it occurred in almost the same depth in the British dredgings, viz.:—

	Station.	Lat.	Long.	fms.
'Lightning,' 1868	. 6	60° 45' N.	4° 49' W.	510
'Porcupine,' 1869	. 90	59 41	7 34	458

10. *Diastylis stygia*, G. O. Sars.

1871. *Diastylis stygia*, G. O. Sars, (Efvers. af Kongl. Vet.-Akad. Förhandl. p. 798.

1873. *Diastylis stygia*, G. O. Sars, Om Cumaceer fra de store dybder i Nordishafvet, Kongl. Vetensk.-Akad. Handl. xi. p. 6, pl. ii. figs. 4-7.

A female measuring 6 millims. comes so near to *D. stygia* that I here assign it to that species; the carapace is longer in proportion to the free cephalothoracic segments, being nearly twice their length; the anterior dorsal margin of the free segments is not crenulated; the pleon is quite smooth; the telson and uropods very like those of *D. stygia*; the peduncle of the latter has ten slender marginal spines, and the inner ramus has seven spines on 1st, three on 2nd, and two on 3rd joint; there is a spine on the abdomen, between the last pereopods.

An immature male has the carapace as in female, except that the denticulations of the infero-anteal margin are larger and stronger, the first five abdominal segments are smooth

(the last two segments being mutilated in the specimen), and the first two are furnished with swimming-feet.

The slight differences in the above characters from those of the type might, for the most part, be easily accounted for by difference in age and size, as Sars's specimen measured 10 millims.; the only points of distinction of any consequence are:—1st, that although the 'Porcupine' specimen is smaller, it has more spines on the uropods than Sars's; and 2nd, the presence of a spine between the *last* legs*. It must be left to the future to determine whether there is any value in these distinctions.

'Porcupine' Expedition, 1869, Station 36, lat. 48° 50' N., long. 11° 9' W., 725 fathoms.

Sars says of his type of *D. stygia*, "Habitat in mari arctico, latit. 78°, longit. occident. 2° 28', in profunditate portentosa 2600 orgyarum."

11. *Diastylis Bradyi*, n. sp.

Female. *Cephalothorax* having the dorsal margin unusually straight, the depth not being very unequal throughout; subequal in length to the pleon, exclusive of the telson. *Carapace* as long as the free segments; lateral margin very minutely serrated throughout almost its entire length; surface with scattered spines of small and subequal size, and ornamented with lines of small spines, the points of which are directed forwards. These lines of spines map the carapace out into areas as follows:—The central lacinia is surrounded by what is a plica in front, but a row of spines at its hinder portion, and it is crossed by two transverse spine-rows; the anterior of these passing into the lateral lacinia terminates at its junction with an arched spine-row, which, taking its origin from the lateral margin, sweeps upwards and forwards to the rostrum; the second transverse spine-row passes right down to the lateral margin; further back is a third transverse spine-row, which, crossing the dorsum, curves at the sides forwards and either dies out or joins the second transverse spine-row. The anterior *free segments* have their front dorsal margin very minutely crenulated; the last is widely separated from the preceding segment, and remarkable in its form and character; behind, the epimera (in both sexes) are greatly produced into large spine-like processes, while the anterior dorsal margin is cut into large teeth, alternating with conspicuous plumose setæ,

* I cannot say whether my specimen has the spines between the first three pairs of legs, which characterize *D. stygia*, as I was unwilling to mutilate the only specimen, which would have been necessary to get a good view of this part.

which have a backward direction. The *pleon* has small spines (in both sexes) on the ventral surface of the fourth, fifth, and sixth segments, but chiefly on the fifth. *Upper antennæ* reaching beyond the rostrum by the last very long joint of the peduncle; flagellum 3-jointed, as long as the last joint of the peduncle; shorter flagellum small, not longer than the first joint of the longer flagellum. The *first feet* have the three terminal joints subequal; first joint of all the legs, and even the basal joint of their palps, spinose; last three legs very robust. *Telson* with about fourteen spines on each side. *Uropods* with twenty-five lateral spines on the peduncle; inner branch with 1st joint bearing eleven spines on the inner margin, 2nd three, 3rd three and terminal spine; outer branch having about fifteen cilia on the exterior margin. Length 11 millims.

Immature male. Length 9 millims. Like ♀ in character of carapace, pereion, pleon, legs, &c.; *telson* with ten lateral spines; *uropods* having their peduncle equal in length to the telson and bearing eighteen spines on the inner margin; inner branch having 1st joint furnished with eight spines, 2nd with four, 3rd with three and terminal spine.

Dredged during the 'Porcupine' Expedition of 1869, in Lough Swilly, co. Donegal, in 15 fathoms.

I have named this species after my friend Professor G. S. Brady, who has added so much to our knowledge of the Entomostraca of our seas.

12. *Diastylis lævis*, Norman.

1869. *Diastylis lævis*, Norman, Last Report Shetland Dredging, Brit. Assoc. Report, 1868 (1869), p. 270.

Professor Sars has given the above as a synonym of *D. tumida*, Lilljeborg. It certainly comes very near it, but is, I think, distinct. At the time I drew up the description of *D. lævis* I had by my side (a) specimens of *D. tumida* received from Professor Lovén, (b) Sars's description of that species. In describing my species, in order to draw attention to the strong points of resemblance, I adopted almost the very words of Sars's description wherever they were applicable. I have now also by me specimens received from the Professor as *Diastylis tumida*. The points of distinction seem to be as follows:—1st, the carapace of *lævis* is much more elongated and much less deep; 2nd, the telson is of a different form; in *D. lævis* the part posterior to the anal aperture is always markedly longer than the basal portion, whereas in *D. tumida* it is usually much shorter, never apparently longer; 3rd, in the much more numerous spines of telson and uropods in *D. lævis*.

A *female* taken in the 'Porcupine' has seventeen spines on each side of the telson, and the uropods have twenty-four spines on the peduncle; inner ramus, 1st joint seven, 2nd four, 3rd three spines; the outer ramus is longer than the inner, its inner margin is smooth, but the outer margin and face carry fifteen setæ besides three terminal smooth setæ. An *immature male*, measuring 10 millims., has eleven pairs of spines on the telson; uropods with twenty-three spines on the peduncle; inner ramus, 1st joint eight, 2nd four, 3rd three spines; outer ramus has only seven very small setæ on the external margin. The last segment of the pereion has strongly produced epimera, and the anterior dorsal margin is both strongly serrated and adorned with plumose setæ. When the pleon is viewed from above, rows of spines are seen on each side of the segments; the hinder spine of each segment is larger than those before it; and, as seems to be general with the males in this genus, the spines of the fifth segment are the most developed*.

'Porcupine' Expedition, 1869.

Station		Lat.	Long.	fms.
6	. . .	52° 25' N.	11° 40' W.	90
"	11 . . .	53 24	15 24	1630
"	18 . . .	54 15	11 9	183

13. *Diastylis Edwardsii* (Krøyer).

1841. *Cuma Edwardsii*, Krøyer, Naturhist. Tidssk. iii. pp. 504, 531, pl. v. figs. 1-16; id. op. cit. anden rækkes ii. (1846), pp. 128, 207, pl. i. figs. 1, 3, 5, 9-14; id. Voyages en Scandinavie &c. pl. iv.

1846. *Cuma brevirostris*, Krøyer, Naturhist. Tidssk. anden rækkes ii. pp. 174, 208; id. Voyages en Scandinavie &c. pl. v. A. fig. 1 a-t (mas adultus).

Carapace tumid, not remarkably deep or broad, occupying about three fifths of the length of entire cephalothorax, with five denticulately edged plicæ on each side, the first curving directly forwards and running right out to the end of the rostrum; the second branching laterally from the first and proceeding towards the lateral margin, which, however, it does not reach; the third running right down from above to the lateral margin; the fourth and fifth curving forwards and looping with the third plica, which they join; rostrum short, hispid. *Free segments* of cephalothorax having their anterior margin elegantly denticulated. *First pereiopods*, when extended forwards, reaching beyond the rostrum by the last two

* My description of the first feet in the Brit. Assoc. Report is incorrect. These organs do not differ materially in the proportional length of the joints from *D. tumida*.

joints and half of the antepenultimate; first joint strongly spined on the outer margin. *Pleon* having the fifth segment spinose on the posterior margin. *Telson* with nine pairs of lateral spines. *Uropods* having peduncle edged with fourteen spines; inner branch, 1st joint with six, 2nd with two, 3rd with two marginal spines. Length 11 millims.

Young male (sexual characters not fully developed) has the telson with seven pairs of lateral spines, and uropods with eleven spines on peduncle, four on 1st, two on 2nd, and two on 3rd joint of inner branch, and four small spine-like setæ on outer margin of external branch.

'Valorous' Expedition, off Holsteinborg, Station 5, lat. 66° 59' N., long. 55° 27' W., 57 fathoms.

This species approaches, but is quite distinct from, the N.E.-American *Diastylis sculpta* of Sars.

14. *Diastylis strigata*, n. sp.

Male. Carapace with antero-lateral corner produced forwards in the form of a well-rounded and strongly serrated lobe; rostrum short, spinose on the sides; surface of carapace not spined, having two transverse and vertical plicæ on the anterior portion, and a third longitudinal plica running nearly parallel with, and a little within, the lateral margin, and joining the posterior of the vertical plicæ at nearly a right angle; these plicæ are all quite smooth (neither serrated nor spine-crowned). *Inferior antennæ* reaching beyond the extremity of the uropods. *Cephalothorax* having the anterior dorsal margin of the last segment serrated, and the epimera produced backwards into well-developed pointed lobes. *Last pereopods* have the basal joint excessively flattened throughout the greater part of its length, but rounded at the distal extremity. *Pleon* with a crest of three spines on the under-side of the first segment (similar in position and character to those of *D. longipes*, but fewer in number and of smaller size); viewed from above, the 1st and 2nd segments are seen each to have a pair of minute spines transversely placed; 3rd, 4th, and 5th segments have a central dorsal line of minute spines; these lines of spines are confined to the posterior portion of each segment, and the hindermost spine in each row is the largest; these three segments have also a crest of spines on the external angles of the ventral surface; the spines composing these ventral crests are of much larger size than those of the dorsal surface; and the crests of the 5th segment are more developed than those of the preceding segments (as is usual in males of the genus). *First joint of posterior maxillipeds* and of *first pereopods* unarmed, except that there is a single

distal spine; penultimate joint of first legs longer than, and commonly folded back upon, the antepenultimate; last joint about half the length of preceding. *Upper antennæ* with filaments longer than usual, the longer equalling the last two joints of peduncle, the shorter as long as the last joint. *Pleopods* well developed on first and second segments of pleon.

Telson with six to seven pairs of lateral spines. *Uropods* very slender; peduncle furnished with about twenty-five complex spines on the inner margin; inner ramus with the three joints subequal in length, 1st with sixteen to eighteen, 2nd with seven to eight, 3rd with four to six spines; outer ramus longer than the inner, with two to three short setæ on internal, and five to six on external margin. Length 7 millims.

One specimen dredged in Lough Swilly, co. Donegal, in 15 fathoms, 'Porcupine,' 1869. In the following year I took the species in the tow-net off Valentia.

15. *Diastylis Calveri*, n. sp.

Male. *Cephalothorax* much wider than deep. *Carapace* not deep, dorsal line only slightly arched; surface not spined, with two curved plicæ on the central portion, and extending from the dorsal line to the margin; numerous little pits stud the surface; and the stomachal region is furnished with numerous lucid spots (as in *D. sculpta* and other species); lateral margin unusually straight, strongly serrated in front; rostrum very short, blunt, and broad, hollowed above at the base. *Third free segment* with a pair of dorsal spines; first, second, and last denticulately serrated on the front dorsal margin; epimera of last segment only slightly produced backwards, and bearing two or three plumose setæ. *Pleon* with a pair of thorn-like spines on the under surface of first segment, a spine at the dorsal posterior angle of each segment, and a spine at the posterior ventral angle of the first two segments. *First pereopods* extending beyond the rostrum by their last two joints, the first of which is longer than the antepenultimate and three times as long as the last joint. *Telson* and uropods very slender; the telson has the anal aperture very far back, almost at its commencement, and at some distance from the end of the thicker anterior portion; this anterior portion is channelled above, the edges of the channel being serrulated; distal and more slender portion of telson with five pairs of very slender lateral spines; terminal spines largely developed and long. *Uropods* with eight to eleven spines on inner margin of peduncle; inner ramus having 1st joint with nineteen to twenty-two, 2nd with four, 3rd with three and terminal spines, the whole of the inner margin is also minutely pectinate, with ex-

cessively minute spinules between the spines just enumerated; outer ramus reaching only to the end of the second joint of inner, very narrow and slender in structure, with about eight small slender setæ on each margin. Length 8-9 millims.

Two specimens, 'Porcupine' Expedition, 1869. Station 11, lat. $53^{\circ} 24' N.$, long. $15^{\circ} 24' W.$, 1630 fathoms.

I have named this species in honour of Captain Calver, the able commander of H.M.S. 'Porcupine,' to whose nautical skill, untiring zeal, and keen appreciation of the value of scientific research, exhibited in his able and successful conduct of the 'Porcupine' Expeditions, natural history owes so much.

16. *Diastylis armata*, n. sp.

1876. *Diastylis armata*, Norman, MS., 'Valorous' Report, Proc. Royal Soc. xxv. p. 212.

Female. *Cephalothorax* short; free segments remarkably short, scarcely half as long as the carapace, the three posterior segments developed as usual, but the two before these only indicated by a narrow fillet. *Carapace* broad, deep, and tumid; length only half as much again as depth; dorsal margin boldly arched in the centre, declining posteriorly, and still more anteriorly in the sweep to the rostrum; posterior margin abruptly truncate; lateral margin strongly arched in the centre, where the carapace attains its greatest depth; anteriorly the margin is serrulate; serrulations about twenty, increasing in size in front; no infero-anteal angle, the lateral margin gradually sloping upwards to the rostrum; rostrum short, reaching the middle of the second joint of the peduncle of the upper antennæ, its sides rapidly converging to the acute point in which it terminates; surface of carapace for the most part glabrous and devoid of spines, sculptured with scattered little shallow pittings; the rostrum bears a pair of conspicuous, acute, erect spines; behind these each lateral lacinia bears a longitudinal curved row of four spines, the anterior of which is similar to those on the rostrum, but the hinder ones very small; beneath this row, between it and the lateral margin, is an isolated triangular spine of small size. The *free cephalothoracic segments* and those of pleon are all quite smooth, save that the epimera of the last cephalothoracic segment are armed with a spine (but not produced backwards). *Upper antennæ* have the three joints of peduncle subequal, the first armed with a spine at the extremity on the lower side. *First legs* with the basal joint strongly armed with spines all along the margin. *Pleon* exceeding the length of the cephalothorax by its last two segments. *Telson* longer than the peduncle of the uropods,

having the basal portion longer than usual (exceeding the length of the sixth segment); only three pairs of small lateral spines, but the terminal fork long and slender. *Uropods* weakly formed; peduncle narrow, but slightly widening distally, with only three small spines on the inner margin; inner branch rather shorter than the outer; external margin quite smooth, inner with two spines on 1st, two on 2nd, one and a terminal spine on 3rd joint; outer branch narrow and delicately formed, quite smooth on both sides, devoid both of spines and setæ, terminating in a long and very slender spine. Length 10 millims.

One specimen taken by the 'Valorous' at the entrance of Davis Strait, Station 9, lat. 59° 10' N., long. 50° 25' W., 1750 fathoms.

Genus *LEPTOSTYLIS*, G. O. Sars (1869).

Leptostylis producta, n. sp.

Cephalothorax remarkably short and tumid, not half as long as the abdomen (exclusive of the uropods). *Carapace* very short, broad, and gibbous, abruptly truncate behind, length not greater than breadth; rostrum short, rounded, slightly bent upwards; surface smooth, or nearly so; lateral margins strongly denticulately serrated, infero-anteal corner not produced. *Telson* short, scarcely more than one third as long as basal joint of uropods; not longer than sixth, and not more than half the length of the fifth segment; no lateral spines; terminal spines two, large in proportion to size of telson. *Uropods* having the base nearly three times as long as the telson, slender, with four long, widely distant spines on the inner margin; inner ramus long, styliform, nearly as long as the basal joint, 1st joint with two, 2nd with one long spine on inner margin, 3rd joint much produced, gradually attenuated to a fine point, no spines on the inner margin; outer ramus only equalling in length the first joint of the inner ramus, slender, and scarcely exceeding in size the terminal joint of the inner ramus.

A single specimen procured in the 'Porcupine' Expedition, 1869, off the Butt of Lewis, Station 90, lat. 59° 41' N., long. 7° 34' W., 458 fathoms.

Genus *CHALAROSTYLIS*, n. g.

(χαλαρὸς, laxus; στῦλος, stilus.)

Male. General characters the same as in *Diastylis*, but furnished with three pairs of feet on the pleon, each consisting of a

long peduncle and two branches furnished with plumose setæ. Telson short, terminating in three spines (instead of the usual fork). Uropods remarkably long and slender. *Female* unknown.

Chalarostylis elegans, n. sp.

Male (adult). *Cephalothorax* equal in length to five abdominal segments. *Carapace* shallow, but wide, length three-fifths of entire cephalothorax; dorsal margin well-arched on hinder portion, but depressed on the anterior two thirds of its length; surface microscopically spinulose; lateral margin not serrated, gradually sloping upwards, without any sinus, to the extremity of the rostrum; anterior margin (*i. e.* slope from lateral margin) edged with about fifteen spines; anterior portion of dorsal margin with a crest of about ten small spines. *Anterior margin* of free cephalothoracic segments smooth; epimera of last segment not posteriorly produced. *Pleon* quite smooth and glabrous. *Upper antennæ* with the basal joint covered with numerous spines, especially on the underside. *Lower antennæ* as long as cephalothorax, with last joint of peduncle and also the flagellum furnished with very numerous semiverticils of crowded cilia. *First feet* having first joint more slender than usual, not spined, with three to four verticillately plumose short setæ on the hinder margin; 2nd joint very short, armed with one long spine; 3rd joint longer, having one long spine; 4th very long, almost as long as three upper joints, and much longer than two following combined, armed with ten spines, of which two are much longer than the rest, and of the same size as the large single spine on the preceding joints; penultimate joint very short, about one fifth the length of 4th; last joint three times as long as penultimate, terminating in spine-like setæ. *Three pairs* of abdominal feet, each consisting of a long peduncle (as long as the depth of the pleon), minutely spinous on the hinder margin, and two branches furnished with plumose setæ. *Telson* short, equalling length of sixth segment, but not much more than half the length of fifth, with two pairs of lateral spines, and terminating in three spines (instead of the usual fork). *Uropods* remarkable for their great length and slenderness; peduncle three times the length of telson, with twenty-four spines on the inner margin; inner branch with first joint as long as telson, with eight marginal spines, 2nd with two, 3rd without any marginal spines; outer branch reaching to the middle of the last joint of the inner branch, 1st joint with three spine-like setæ on inner margin,

and 2nd with four such setæ on inner margin and three terminal setæ; outer margin without setæ. Length rather more than 8 millims.

One taken, 'Porcupine,' 1869, off Rockall, in 109 fathoms.

Genus SPENCEBATEA, n. g.

(Named after Mr. C. Spence Bate.)

Characters of Male.—General aspect that of *Diastylis*. Five segments of cephalothorax exposed behind the carapace. All feet, except the last, palpigerous. No feet on pleon. Telson rudimentary (as in *Eudorella*). Uropods with both branches two-jointed. *Female* unknown.

Spencebatea abyssicola, n. sp.

Male. *Cephalothorax*, viewed laterally, long ovate, the upper margin a bold gradual curve from the rostrum to the last segment. *Carapace* three fifths of the length of entire cephalothorax, shallow and of nearly equal depth throughout; dorsal margin evenly arched; lateral margin inarched and exposing all the feet to their very bases, entire throughout (*i. e.* not denticulated); rostrum very short, suddenly and broadly truncated, its inner sheath projecting considerably beyond the outer; entire surface of carapace showing a structure composed of hexagonal cells, not at all spinous; but a few hairs are scattered on carapace, free segments, and pleon. *Last cephalothoracic segment* having a pair of spines on the ventral surface between the slender legs; a pair of minute spine-like points are also present on the back of this segment. *Telson* rudimentary. *Uropods* greatly developed, equal in length to the last four abdominal segments; peduncle much longer than the rami, with eight cilium-tipped spines on the inner margin; inner branch consisting of a long first joint having eight long spines on the inner margin, and a terminal greatly developed spine, which might be considered a second joint, and has been so called in the generic description; outer branch much smaller, shorter and more slender, 1st joint short, 2nd with one minute spine on inner and one small seta on outer margin, terminating in two slender spines, one of which is of great length and very slender.

A very small species, only measuring 4 millims.

A single specimen, 'Porcupine,' 1869, Station 19, west of Donegal Bay, lat. $54^{\circ} 53' N.$, long. $10^{\circ} 56' W.$, 1360 fathoms.

Genus *LAMPROPS*, G. O. Sars (1864).1. *Lamprops rosea* (Norman).

1863. *Vaunthompsonia rosea*, Norman, Trans. Tyneside Nat. Field Club, v. p. 271, pl. xiii. figs. 1-3 (femina adulta).

1863. *Cyranassa elegans*, Norman, Trans. Tyneside Nat. Field Club, v. p. 275, pl. xiv. figs. 1-6 (mas adultus).

1864. *Lamprops rosea*, G. O. Sars, Om Cumacea, Vid. Selsk. Forhandl. p. 64.

'Porcupine' Expedition, 1869, Lough Foyle, 15 fathoms.

2. *Lamprops cristata*, G. O. Sars.

1869. *Lamprops cristata*, G. O. Sars, Nye Dybvandskrustaceer fra Lofoten, Vidensk. Selsk. Forhandl. p. 157.

'Porcupine,' 1869, south of Rockall, Station 23, lat. 56° 7' N., long. 14° 19' W., in 630 fathoms.

Genus *IPHINOË*, Bate (1856).

(=*Halia*, Bate, 1856, in use for genera of Mollusca and Lepidoptera.)

Animal greatly elongated. *Cephalothorax* low, narrow, compressed, greatly produced, generally having the dorsal line of carapace spined in female; rostrum produced; five free segments of pereion, the last two subequal, scarcely wider or higher than the pleon. *Second maxilliped* having the basal joint longer than the remainder taken together, first and second joints distally furnished with a long plumose seta, last joint in the form of a strong nail. *Third maxilliped* having the first and third joints produced into very large setiferous lobes on the inner distal extremity; the lobe of the first joint reaches at least to the middle or end of the third joint, that of the third joint extends to the middle of the fourth joint. *Pereiopods*, only the first, even in the male, furnished with palpi; second pair much smaller than usual and more like the following pairs. *Telson* rudimentary, but bilobed. *Uropods* strongly developed, both branches two-jointed; outer joint flattened, truncate at the apex. The male has the first five segments of pleon furnished with swimming-feet, and the spines on the dorsal line of the carapace usually (? always in adult) absent.

This genus was established by Bate (Ann. & Mag. Nat. Hist. 1856, 2nd ser. vol. xvii. p. 458) under the name *Halia*, with the *Cuma trispinosa*, Goodsir, as the type. Subsequently finding that *Halia* was already in use for a genus of Lepidoptera, he changed the name to *Iphinoë* (Ann. & Mag. Nat. Hist. 1856, 2nd ser. vol. xviii. p. 187).

The members of this genus bear a striking general resem-

blance to *Leucon*; but in that genus three pairs of pereopods are furnished with a palp, and the male has only two pairs of swimming-feet on the pleon.

Iphinoë serrata, Norman.

1866. *Iphithoë serrata*, Norman, Report of Committee for exploring Coasts of the Hebrides, Brit. Assoc. Report, 1866 (1867), p. 201.

1868. *Iphinoë serrata*, Norman, Brit. Assoc. Report, 1868 (1869), p. 272.

'Porcupine,' 1869, Station 20, lat. $55^{\circ} 11' N.$, long. $12^{\circ} 46' W.$, 1443 fathoms.

Genus *LEUCON*, Kröyer (1846).

1. *Leucon longirostris*, G. O. Sars.

1871. *Leucon longirostris*, G. O. Sars, Beskr. af Fregatten Josephines Exped. Cumaceer, Kongl. Vet.-Akad. Handl. vol. ix. p. 42, pl. xv. fig. 75.

The type of this species was procured in 550 fathoms off the coast of Portugal during the 'Josephine' expedition. It was only a fragment, part of the pleon being broken off.

A single specimen dredged in the 'Valorous' expedition, at the entrance of Davis Strait, lat. $59^{\circ} 10' N.$, long. $50^{\circ} 25' W.$, in 1750 fathoms, agrees very closely with Sars's beautiful figure.

I add a few notes, chiefly on that portion of the animal which was absent in the type specimen. The specimen examined by me is a female; that observed by Sars was a male.

Number of dorsal spines of carapace seven, of the under-side of the rostrum four, of the antero-lateral margin nine; and there are two small spines close together on the front margin between the antero-lateral corner and the base of the rostrum.

The first legs are very long and remarkably free from setæ; the thigh is armed with two spines.

On the belly between the last pair of legs is a thorn-formed spine with the point curving forward.

Pleon having the first five segments gradually increasing in length, but the fifth twice as long as the sixth; telson very short.

Uropods broad and flattened; peduncle with two spines on the inner margin; inner branch with eleven spines on the inner margin (nine on 1st joint, two on 2nd), and terminating in a long spine; the second joint not one third the length of the first; outer branch as long as the first joint of the inner

branch, its first joint very short and unarmed, second having one simple and two plumose spines on the inner margin and terminating in two very long spines. The spines of the inner margin of the inner branch are all tipped with a little cilium; and the two long spines of the outer branch, which I have called "plumose," are of very peculiar structure: their basal portion under the microscope appears as if furnished with stiff hairs; but the apical portion would perhaps be more correctly described as pectinate.

The peculiar production of the rostrum in this species is a very remarkable feature.

From the wide distance apart at which the only two known examples were found, it is probable that *Leucon longirostris* will prove to be widely diffused over the bed of the Atlantic Ocean.

2. *Leucon nasicus*, Kröyer.

1841. *Cuma nasica*, Kröyer, Naturhist. Tidsskrift, vol. iii. p. 524, pl. vi. figs. 31-33.

1846. *Leucon nasica*, Kröyer, Naturhist. Tidsskrift, and. rækkes vol. ii. pp. 189, 209, pl. ii. fig. 5, *a, b*; id. Voyages en Scandinavie &c. pl. iii. fig. 2, *a-o*.

1855. *Leucon nasica*, Lilljeborg, Öfvers. af Vetensk.-Akad. Förh. p. 121.

1864. *Leucon nasicus*, G. O. Sars, Om Cumacea, Vid. Selskab. Forhandl. p. 53.

A single specimen taken by the 'Porcupine' expedition in 1869 in the Minch. Not before known as belonging to the British fauna.

3. *Leucon serratus*, n. sp.

1876. *Leucon serratus*, Norman, MS., 'Valorous' Report, Proc. Royal Soc. vol. xxv. p. 212.

Female. *Carapace* much longer than the free segments of cephalothorax and very deep, the depth being subequal to the length, exclusive of the rostrum; dorsal margin boldly arched, having a continuous unbroken serrated line throughout its length; serrations triangular, small posteriorly, and gradually increasing in size forwards; rostrum, viewed laterally, short, deep, triangular, directed horizontally in front of the point where the dorsal line sweeps down to meet it, its edge with a few elongate serrations; antero-lateral corner produced forwards and outwards in wing-like form; lateral margin with about ten elongated triangular serrations, of which the three or four front (on the wing-like expansion) are much larger than the rest. Total length of *pleon* (without uropods) not exceeding that of the cephalothorax. *Upper antennæ* very small, just reaching to the end of the rostrum. *First feet* having

seven spines on the hinder margin of the first joint; the last three joints gradually decrease in length; and the limb does not reach beyond the extremity of the rostrum. *Telson* rudimentary. *Uropod* with a peduncle not exceeding in length the 5th segment of the pleon, bearing three spinules on the inner margin; inner branch much shorter than the outer, 1st joint with five spines, of which the distal is much the largest, on the inner margin; second joint with five spines, which gradually increase in length distally, on the inner margin, one distal spine on the outer margin, and a terminal spine, which is two thirds as long as the joint from which it springs; outer branch having the first joint short and unarmed, the second very long, with two or three minute setæ on the outer margin, and long setæ on the distal portion of the inner margin and at the apex. Length 6 millims.

One specimen taken in the 'Valorous' expedition at the entrance of Davis Strait, Station 9, lat. 59° 10' N., long. 50° 25' W., in 1750 fathoms.

4. *Leucon brevirostris*, n. sp.

Female. *Cephalothorax* equal in length to five segments of pleon. *Carapace* longer than the free segments, ovate, deep, gently arched above, compressed; infero-anteal angle greatly produced and terminating in a sharp point, with five serrations; rostrum unusually short, broad, rounded, minutely serrated on the edge; dorsal line toothed more or less throughout, but the teeth separated by intervals posteriorly, where they are small, increasing in size and closeness to each other in front, about twenty in all; the teeth are not regularly arranged, as usual, in single file, but in an irregular double alternating line; surface everywhere ornamented with very pretty and regular hexagonal celled structure; carapace, seen from above, widest behind the middle, gradually and evenly narrowed thence to the extremity of the rostrum.

Third maxilliped with the first joint strongly spined, the four or five more distal spines of great size and thorn-like form, the lobe of this joint greatly developed, reaching forward to the end of the third joint, and its long setæ extending to the end of the penultimate joint; second joint armed with one spine, similar in character to those of first joint. *Telson* very short, semioval, smooth. *Uropods* with peduncle slightly longer than the fifth segment of the pleon, having five long spines on the inner margin; inner branch with first joint longer than the second, having ten spines of unequal length on the inner margin; second joint with five spines on the inner margin and two longer at the extremity; outer branch

longer than the inner, and longer than the peduncle: first joint short; second with four hair-like spines on the inner margin and two long setæ at the extremity. Length 10 millims.

'Porcupine,' 1869, dredged in 109 fathoms, to the south of Rockall, lat. $56^{\circ} 26' N.$, long. $14^{\circ} 28' W.$

The short rostrum distinguishes this at once from *L. nasicus* and *pallidus*; the absence of the three spines on each side of the central line of the middle lacinia from *L. nasicoideus*; and the more numerous teeth of the crest from *L. fulvus* and *L. acutirostris*.

Genus EUDORELLA, Norman (1867).

(=*Eudora*, Bate, 1856; name preoccupied.)

1. *Eudorella truncatula*, Bate.

1856. *Eudora truncatula*, Bate, Ann. & Mag. Nat. Hist. ser. 2, xvii. p. 457, pl. xiv. fig. 3.

1864. *Eudora truncatula*, G. O. Sars, Om Cumacea, Vid. Selskab. Forhandl. p. 61.

1867. *Eudorella truncatula*, Norman, Brit. Assoc. Report, 1866 (1867), p. 197, note.

1871. *Eudorella truncatula*, G. O. Sars, Kongl. Vetensk.-Akad. Handl. ix. p. 44, pl. xviii. fig. 99.

'Porcupine,' 1869, Station 20, lat. $55^{\circ} 11' N.$, long. $11^{\circ} 31' W.$, 1443 fathoms.

2. *Eudorella hirsuta*, G. O. Sars.

1869. *Eudora hirsuta*, G. O. Sars, Undersøgelser over Christianiafjordens Dybvandsfauna, p. 43.

1871. *Eudorella hirsuta*, G. O. Sars, Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceen, Kongl. Vetensk.-Akad. Handl. ix. p. 44, pl. xviii. fig. 100.

A 'Porcupine' *Eudorella* is so near *E. hirsuta* that I prefer provisionally considering it a variety of that species to giving it a distinctive name. I give, however, the characters.

Cephalothorax deepest at the anterior part of the carapace, and thence gradually becoming shallower to the last segment, which is not deeper than the abdomen. *Carapace* subequal in length to the free segments; front margin truncate, but not retuse, the lower two thirds of this margin and also the lateral margin denticulate throughout; denticulations of nearly equal size; infero-anteal angle well rounded off; a narrow sulcus at about one-fourth-way up the anterior margin, but the denticulations are not interrupted even by this sulcus, but pass down into it; there are about six denticulations from the bottom of the sulcus to the infero-anteal corner, and about ten

above, counting from the bottom of the sulcus; surface not strongly hispid (as in *hirsuta*), only a few scattered hairs, sculptured with roundish or hexagonal cells. *Uropods*: peduncle not broad, the length much less than that of fifth segment of pleon, and about four times its own breadth; the anterior half of the inner margin bearing four little hairs, while the more distant portion has two spines; inner ramus longer than the peduncle or the outer branch, the first joint has eight spines on inner and three little spine-like setæ on outer margins, the 2nd joint has three spines on the inner and two distal spines on outer margin besides the terminal spine; outer branch has the first joint glabrous, the second with thirteen spine-like setæ. Length 5 millims.

'Porcupine,' 1869, midway between Ireland and Rockall, in 1380 fathoms (Station 30, lat. $56^{\circ} 24' N.$, long. $11^{\circ} 49' W.$).

Genus *CAMPYLASPIS*, G. O. Sars (1864).

Campylaspis rubicunda (Lilljeborg).

1855. *Cuma rubicunda*, Lilljeborg, Öfvers. af Vet.-Akad. Förhandl. p. 121.

1864. *Campylaspis rubicunda*, G. O. Sars, Om Cumacea, p. 77.

1873. *Campylaspis rubicunda*, G. O. Sars, Om Cumaceer fra de store dybder i Nordshavet, Kongl. Svenska Vetensk.-Akad. Handl. xi. p. 10, pl. iv. figs. 14-16.

Off Holsteinborg, Greenland, 'Valorous,' Station 5, lat. $66^{\circ} 59' N.$, long. $55^{\circ} 27' W.$, 57 fathoms; one specimen.

Genus *CYCLAPIS*, G. O. Sars (1864).

Cyclapis longicaudata, G. O. Sars.

1864. *Cyclapis longicaudata*, G. O. Sars, Om Cumacea, p. 82.

Off the Spanish coast, 'Porcupine,' 1870, Station 9, lat. $48^{\circ} 6' N.$, long. $9^{\circ} 18' W.$, 539 fathoms; and North Atlantic, 'Valorous,' 1875, Station 12, lat. $56^{\circ} 11' N.$, long. $37^{\circ} 41' W.$, 1450 fathoms.

REMARKS
ON
THE RECENT *ERYONTIDÆ*.

BY
The Rev. A. M. NORMAN, M.A.

I AM sorry that Mr. Spence Bate's reply to my inquiries respecting the Crustacea described by him in a paper "On the *Willemoesia* group of Crustacea," which appeared in the 'Annals' of December last, has remained so long unnoticed by me. Unfortunately I have been so occupied by duties that I have had no time for writing since the commencement of the year.

Mr. Spence Bate's paper just referred to was on a subject of the greatest interest. In it were described a number of Crustacea discovered by the 'Challenger' in the abyss of the ocean, extremely closely related to a group of animals which, until recently, were believed to have been extinct for countless ages; for they had only been met with in old fossiliferous strata. The recent forms which have now been found are so closely the counterparts of their ancient brethren, that they mimic even minute details of sculpture in the several segments of the body. Yet, at the same time, I found conclusions drawn that were totally at variance with those at which I had arrived from the examination of two specimens of these animals which were dredged off the coast of Spain by the 'Porcupine' expedition of 1870.

Mr. Bate's conclusions were to me startling; but I did not venture to say that they were wrong, since, with the mass of

material at his command, he had advantages in arriving at a definite opinion which I had not myself enjoyed. The matter, however, was of too great interest to pass by—of so much interest, not to myself only, but to many others, that it seemed the best way to ask Mr. Bate to give us further information upon the points in question.

I am well aware that the style of my writing was terse. I adopted the form of abrupt questions for brevity's sake; for I was compelled to compress my observations into the small space of three pages, which had been kindly accorded to me by the Editors of the 'Annals' at a late period, when the matter for the issue of the next month's number had already been determined on. I regret that it would seem that this brevity savoured to Mr. Spence Bate of discourtesy.

Whether he is in the right or I am right in the views which we respectively hold is a matter of no moment to myself, if only the discussion of the points in question tends to throw more light upon the subject.

My first and most important question was, "Are his genera *Pentacheles* and *Willemoesia* any thing more than the other sex of *Polycheles*?" The first words of the reply are, "Having just given a paper to prove that they are distinct and not one and the same species, I beg to repeat that *Pentacheles* and *Willemoesia* are not the other sex of *Polycheles*, and to refer to my paper for details." I have referred again to his paper, only to find, as before, that there was not one single allusion to sex throughout it. It was this very omission which, on first reading his paper, had led me to the suspicion that Mr. Bate had fallen into the error of regarding certain modifications of structure as of generic value, which really were dependent on and characteristic of the sex of individuals of the same species. The information, however, upon the question of sex which was wanting in the first paper has, in the second, been supplied. I will now state the grounds on which my own views were arrived at previously to the publication of Mr. Spence Bate's paper.

1. *The known examples with the last pereopods simple (Polycheles, Bate) were males, while those which had the last pereopods chelate or subchelate (Pentacheles and Willemoesia, Bate) were females; thus:—*

A. Males, with last pereopods simple.

- a. *Polycheles typhlops*, Heller. The type specimen was a male, and has the last pereopods simple.
- b. *Willemoesia crucifera*, Suhm, a male; last pereopods simple.

- c. *Polycheles typhlops*, Heller. A male from the 'Porcupine' expedition, which I had examined, is characterized by the last pereopods being simple.

B. Females; last pereopods chelate.

- d. *Polycheles typhlops*, Heller. A specimen dredged by the 'Porcupine' expedition.
- e. *Willemoesia leptodactyla*, Suhm. A female, having the last pereopods chelate. This specimen is said by Suhm to be a male; but it is clear that he fell into an error as regards the sex; for he says "at the coxal joint of the third pereopod are the genital openings," which statement, together with his figure (pl. xiii. fig. 2) of the first pleopod, clearly prove that the type specimen was a female.

It will thus be seen that before the publication of Mr. Bate's paper all known specimens which had simple last pereopods were males, while such as had those limbs terminated by chelæ were females.

2. *That the male (c) and the female (d) represent the two sexes of one and the same species, and that therefore the achelate or chelate character of the last pereopods is a modification dependent upon sex.*

I stated in my former note that I considered the two specimens taken by the 'Porcupine' expedition (see Proc. Roy. Soc. 1870, p. 154) to be male and female of *Polycheles typhlops*, adding, "my conclusion that their difference is sexual may be wrong." Mr. Bate has commented on these words as though I did not know the sex of the individuals examined; but to any one who reads the whole passage it will be at once obvious that my argument was that those structural differences which he regarded as generic I found to accompany difference of sex, and regarded as sexual. The following detailed description of this male and female will enable other carcinologists in some degree to form their own opinions.

Polycheles typhlops, Heller*.

1862. *Polycheles typhlops*, Heller, Beiträge zur nähern Kenntniß der Macrouren, Sitzungsberichte der Akad. der Wissensch. math.-nat. Cl. Bd. xl. Abth. 1, p. 389, pl. i. figs. 1-6.

1863. *Polycheles typhlops*, Heller, Crustaceen des südlichen Europa's, p. 211, pl. vii. figs. 1, 2.

* If Heller's figures are absolutely correct, the form here described is a different species; but with present knowledge I do not feel justified in giving it a different name to that under which I recorded it in the 'Porcupine' Report (Proc. Roy. Soc. 1870, no. 125, p. 154).

Male. *Anterior margin* of carapace with a strong central spine, flanked on each side with another spine; *lateral margin* bearing seven spines on anterior (hepatic) portion, five spines on the middle division, and about twenty on the branchial portion; *central dorsal line* spined, spines arranged in single or double files, thus—1 (the rostral), 1, 1, 2, 2, 2, 2*; *hinder margin* bearing six spines—the median pair, and on each side of these two spines; a curved row of five spines passes backward from the ocular notch; and a ridge crowned with about fourteen minute spines runs along the branchial region parallel with the lateral margin; still more minute spines are also present on the ridges which divide the gastric from the cardiac and branchial regions and other parts of the carapace. The *pleon* has the first five segments centrally carinated, with a large forwardly curving spine at the anterior end of the carina of each segment; this spine attains its greatest development on the fourth and fifth segments; sixth segment bicarinated, the carinæ nodulous; the sides of all the segments ornamented with small rounded tubercles. *Telson* gradually tapering to an acute termination, its anterior portion with a central carina, while the hinder portion is bicarinate, the carinæ slightly serrulate. *Gnathopods* imperfect; the base of one remains as far as the middle of the meros, the outer margin of portion of the meros which remains bears several small spines. *Last pereopods* with the extremity simple, styliform, much shorter and more slender than the preceding pair. *First pleopods* one-branched, simple, spoon-shaped, the expanded portion thin and transparent, with a central rib. Length 60 millims.

Female in all its general characters and the structure of its limbs closely resembling the male just described, but differs as follows:—*Cephalothorax* bearing on front margin a pair of central spines (instead of a single spine); lateral margin with the spines 6, 3, 8; central dorsal row 2 (rostral), 1, 2, 1, 2, 2, 2; no spines on hinder margin, except the central pair; five spines on hepatic and gastric regions as in male; ridge on branchial region with only five spines; the smaller spines present on the carapace of the male are absent or evanescent. The *pleon* is carinated and armed exactly as in male, and only differs in the minute tubercles on the sides not being developed. *Ocular notch* deeper than in male. *First pereopods* with two spines on the outer margin of the meros, and a

* These are only the more prominent spines; the intermediate spaces between them are furnished, as are all other parts of the carapace, with minute spines, any one of which, a little more developed, would make such a spine as would be counted in the row.

single distal spine on meros, carpus, and manus; lower margin of manus spinulated, edge of finger minutely and exquisitely serrated. *Last pereopods* much smaller than the others, chelate, the finger longer than the thumb. *First pleopods* with the terminal portion styliform. Length 50 millims.

Male taken off Portuguese coast in 220 fathoms, 'Porcupine' Exped. 1870, Station 13, lat. $40^{\circ} 16' N.$, long. $9^{\circ} 37' W.$; female in 257 fathoms (Station 8, lat. $48^{\circ} 13' N.$, long. $9^{\circ} 11' W.$) on the Channel slope.

Now these two crustaceans show a very close resemblance to each other in all general characters, while the points of divergence are only such as might reasonably be expected to result from difference of sex and of size; and I cannot feel myself justified in regarding them as belonging to two species; and still less am I prepared to place them in two genera. The female is much smaller than the male; and this fact and the difference of sex may well account for the less-pronounced character of the spinous adornment of the carapace in the former: it will be observed that the arrangement of the lines of spines is the same in both. I have gone into very minute detail as to the number of spines which compose the rows, because it is only here that any difference can be detected; but no species-splitter has yet gone so far as to base character on such minutiae as these. The male before us, indeed, proves from its own carapace that stress must not be laid on such points; for while one lateral margin has seven spines on the hepatic region, the other has eight. The one important point of distinction between the two 'Porcupine' *Polycheles* is the character of the last pereopods. Is, then, the achelate or chelate structure of these limbs a difference resulting from genus or sex?

3. *Sexual diversity in the last pereopods of the male is a common feature among the Crustacea.*

The male sexual organs are situated at the base of the last pereopods; and while many organs, both of the cephalothorax and pleon, undergo frequently the most remarkable modifications, as indirectly subservient to the sexual functions, in few organs are these modifications more general or more remarkable than in the last pereopods. Many instances might be cited among the higher Crustacea, while among the Copepoda the varied and peculiar modifications of these limbs in the male are found to be of no small importance in the diagnosis both of genera and of species.

4. *Male Crustacea are constantly found to differ from their females by structural differences which, in the aggregate, are far*

more remarkable than those upon which specific and even generic characters are usually based.

This is now so fully proved that it may be laid down plainly as an axiom. As instances of extraordinary divergence in form and structure between the sexes it will suffice to name the order Cumacea, the Isopoda (*Bopyrus*, *Phryxus*, *Gyge*, *Ione*, *Cryptotheria*, *Anceus*, *Tanais*, *Aapseudes*, *Næsa*, &c.), the parasitic Copepoda (*Chondracanthus*, *Brachiella*, *Lernanthropus*, *Lernæopoda*, *Anchorella*, *Strabax*, *Medisecaste*, *Diocus*, and their allies), the Cirripedia (*Ibla* and *Scalpellum*). It would be a long task to attempt to enumerate the multitude of instances in which the different sexes of Crustacea have been described as different species, very often belonging to different genera.

These are the grounds on which the conclusion was arrived at that the chelate or achelate character of the last legs of those recent Eryontidæ which I had seen and of those which had been described was indicative of the sex to which the individual belonged and had no further importance.

Have Mr. Spence Bate's papers changed my views? In his first paper, I repeat, there was not a statement to make me modify it in the slightest degree, inasmuch as the sex of the specimens described was in no case given, while forms were described which apparently closely corresponded in all particulars save in those which he regarded as generic, but which I took to be sexual. I therefore considered that his paper, so far from weakening, gave strength to the opinion which I entertained.

In his second paper, however, in which he was good enough to reply to my inquiries, Mr. Bate has given us the sexes of the species he has examined; and a first glance at the list might seem to argue that he had completely proved his point, and that the divergences were generic and not sexual.

To those, however, who know much of the life-history of the Crustacea the statement will not seem *necessarily* to be quite conclusive.

There are certain rules which should be borne in mind in the study of the Crustacea which seem now to be fully established, and which I will proceed to lay down.

a. *Among the Crustacea, for every female we must be prepared to find, and shall often find, two forms of males.*

b. *One of these males may be expected to resemble the females more or less closely, and will perhaps only be distinguishable by examination of the sexual organs themselves; the other form will exhibit varied and very marked points of divergence from*

the female, sometimes in general contour, but more especially in the structure of the limbs.

c. Different limbs will be thus sexually modified in different groups or in different genera; and these modifications become valuable for the classification of families and genera, while the exact mode of the modification of the particular limb is of much use as specific character.

d. In the case of dimorphous males, the males most closely resembling the females are either immature or, in some instances perhaps, where the males are as large as the adult females, sterile. The second form of male, which is widely divergent from its female, is the fully developed sexual individual; and the alterations of structure are exhibited sometimes in a very different form of carapace, but always in specialized development of certain appendages, which may be either antennæ, mouth-organs, gnathopods, pereiopods, pleopods, or uropods, which become indirectly subservient to the discharge of the function of the impregnation of the female. It is often only at the final moult of the male that these peculiar specialized characters of sex are assumed.

e. From the time of the assumption of the complete sexual character, in some (rare) cases the discharge of the sexual office would seem to be the only thing remaining for the life of the individual, the function of alimentation in part or even wholly ceasing. This extreme case, however, has, I believe, as yet been observed only among the order Isopoda, where we find instances in *Anceus* (Hesse and others), *Tancais* (F. Müller and A. M. N.), *Apseudes* (G. O. Sars, in *Aspeudes anomalus*).

Dimorphous males are known to us in genera of *Macrura*, *Cumacea*, *Isopoda*, *Amphipoda*, *Copepoda*, *Ostracoda*, and perhaps *Cirripedia* ("complemental male," Darwin).

One instance may now be referred to, because it has reference to that group of genera, the *Astacidæ*, to which it was stated, in my former notes, that I agree with Heller in considering *Polychæles* to be perhaps most nearly related.

The freshwater crayfish, *Astacus*, of Europe has its closely allied counterpart in North America in the genus *Cambarus*. In this genus, though not as far as is known in *Astacus*, two forms of the male occur.

The following passage from Hagen will speak for itself:—"The discovery that every species of *Cambarus* possesses two different forms of males was made by Prof. L. Agassiz, and kindly communicated to me.

"The existence of a second form of the male, if it were no

more than a passage or metamorphic form, would not be extraordinary. But the great number of full-grown second-form specimens in every species, which are often even larger than the first-form males, seems to prove that they are individuals which have remained in a sexual stage that does not agree with their corporal development—in short, that they are perhaps sterile.

“The objection that these second-form males may be individuals shortly before or shortly after the casting of the skin, I can surely refute, as I have seen many specimens at this stage of growth, the museum collections exhibiting the animal in all the different phases of its existence.

“Another objection, that the males of the second form, or perhaps those of the first form, are abnormally developed individuals, is refuted by the great number of the two forms existing and living together.

“The conjecture, on the other hand, that the second-form males may be sterile, is really supported by the anatomical examination of the two forms in the principal groups of *Cambarus*” *.

Not only so, but Hagen tells us of two forms of the other sex, and that in certain abnormal females he finds “a tendency to a more masculine development, as in the aforesaid males a tendency to a feminine development” †.

Mr. Bate informs us that he has females of six species of *Willemoesia* and *Pentacheles* (that is, with chelate last pereipods) and males of two, and that he has males of three species of *Polycheles* with simple last pereipods, and females of two. As far as members go (but, of course, numbers are of little or no value), this gives 9 to 4 in favour of my view.

The exceptions are that he has males of *Willemoesia leptodactyla* and *Pentacheles Suhmi* with chelate last feet. I have hinted in this paper, from what we know to occur among other Crustacea, that these males may be either immature, and, not yet having attained their full sexual characters, exhibit still the female form of the limb, or that they may be instances of dimorphous (sterile) males. Indeed it would seem that Mr. Spence Bate is not without doubts as to the location of some of the forms he has described as species; for immediately after the list he adds, “For some time I was hesitating where several species of *Pentacheles* should be placed, as there is a regular gradation from the imperfect to the perfect chelate character of the fifth pereipod; but as I found *Polycheles*, both male and female, with the simple non-chelate foot,

* Hagen, ‘Monograph North-American Astacidæ,’ 1870, p. 22.

† Hagen, *l. c.* p. 17.

at present it appears to me that there is no arrangement so constant as that which I propose."

The other exceptions occur in *Polycheles* (as that genus is defined by Bate), in two species out of three of which he has females with styliform last feet. On examining the figure of *Polycheles crucifer* which accompanies Suhm's paper, it would seem that the inner antennæ are without the scale which is characteristic of *Polycheles* of Heller, and which I stated in my former notes to be the chief character that seemed to separate *Polycheles* from the supposed extinct genus *Eryon*. Can it be that *Polycheles*, as defined by Bate, with simple last pereopods in both sexes, has the inner antennæ without a scale, and is in reality *Eryon*? It would be of especial interest should it prove so; but I am not sure that Bate's fig. 6 does not show the antennal scale to the left of the figure; but in that case it is very remarkable from having a deeply serrated edge.

It seems necessary that I should add a few words respecting the homologues of the eyes in these Crustacea. Mr. Spence Bate has very kindly sent me a copy of plate xiii., in which he has lettered what he considers to be the eyes in the several figures. They are not the same organs which Heller took to be the rudiments of the eyes; and I venture to think that Bate is right and Heller wrong in his homology. But that these organs are used for vision I cannot conceive to be possible. It will be found among the stalk-eyed Crustacea that loss of vision and consequent change of function in what would ordinarily be the eye is accompanied by one or other, or by both, of the following modifications:—1st, *that the eyestalk is no longer movable, but becomes firmly fixed in the socket*; 2nd, *that the eye assumes a difference of form, and is either (a) narrower and pointed, instead of club-shaped at the extremity, and so employed (in some instances at any rate) as an organ of offence, as in *Ethusa granulata*, Norman, or *Cambarus pellucidus*, Tellkamp, or (b), on the other hand, becomes expanded and flattened into a plate, examples of which may be found in the genera *Pseudomma*, G. O. Sars, *Amblyopsis*, G. O. Sars, and *Petalophthalmus*, Suhm.*

Now, in the Crustacea which we are considering, Mr. Bate says, the "eyes" are "immovably lodged," and "the peduncle throughout the group is reduced to a minimum and fixed as a rigid part of the dermal structure;" and with respect to form in *Willemoesia leptodactyla* they would seem, from the figure given, to be not unlike those of *Calocaris McAndrei*, Bell; while in *Pentacheles enthrix* and *Polycheles crucifer*, instead of being club-shaped as in veritable eyes,

they terminate in a long acute point in the one case, and in a "long obtuse point" in the other. The reason why, in my former note, I was not in a position to deny positively that these extremely rudimentary organs had lenses, was because, although the 'Porcupine' specimens showed not the slightest trace of lenses, yet, as they had been preserved in glycerine and subsequently transferred to spirit, it was possible that this treatment might have destroyed lenses which had existed.

Mr. Bate inquired whether I could say there were eyestalks in the young of "*Astacus? zaleucus*, Willemoes-Suhm, *Nephropsis Stewartii*, Wood-Mason, and the blind prawns of the North-American caves." Of the first two only the type specimens are known. It is hardly likely, therefore, that I should be acquainted with their young. With respect to the "blind prawns of the North-American caves," I know of no such Crustacea; and suppose that "prawns" was a slip for "crayfish," and that he refers to the *Cambarus pellucidus* of the Mammoth Cave of Kentucky. That crustacean has eyestalks not only when it is young but in maturity also. "Like the other animals living in caves, it is blind. The eyes are atrophied, smaller at the base, conical, instead of cylindrical and elongated as in the other species. The cornea exists, but is small, circular, and not faceted; the optic fibres and the dark-coloured pigments surrounding them in all other species are not developed"*.

* Hagen, *l. c.* p. 33.

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ART LV.—*On Additions to the Carcinological Fauna of New Zealand.*

By T. W. KIRK, Assistant, Colonial Museum.

[Read before the Wellington Philosophical Society, 31st August, 1878.]

THE publication of a 'Catalogue of New Zealand Crustacea' by the Geological Survey and Colonial Museum Department, has proved a great boon to students and collectors in the colony, by bringing together, in a convenient form, descriptions of all the species known to inhabit these shores, thus enabling them to pronounce, with some degree of certainty, upon any specimen which may be under discussion.

The remarkable resemblance which our fauna bears to that of England and California has been pointed out by many authors. I have now to record the occurrence here of at least two additional European and the same number of Californian species.

Three of the species mentioned in this paper, viz., *Caprella lobata*, *C. novæ-zealandiæ*, and *Libinia tumefacta*, were obtained in Cook Strait, in January, 1876, whilst dredging for the telegraphic cable.

Group ABERRANTIA.

The coxæ of the pereopoda are not squamiformly developed, some of all being fused to their respective segments. The pleon has one or more of the segments absent.

Fam. 2, CAPRELLIDÆ.

Pleon rudimentary: oral appendages normally developed; coxæ fused with the pereion; branchial sacs attached to the first two or three segments of the pereion.

Caprella.

Caprella, Lamarck, Syst. des anim. sans vert., p. 165.

Leach, Linn. Trans. II., p. 363.

Edwards, Hist. des Crust. III., p. 105.

Krøyer, Nat. Tidskr. IV., p. 496, 1842-3.

Ægina, Krøyer, Nat. Tidskr. IV., 1843.

Podalirius, Krøyer, Nat. Tidskr. V., 1844.

Body cylindrical; cephalon and first segments of pereion confluent; pleon rudimentary; gnathopoda subchelate; first two pairs of pereiopoda represented by the branchiæ attached to their respective segments only; three posterior pairs of pereiopoda subequal; first and second pairs of pleopoda rudimentary in the male; the rest obsolete. (Spence Bate, Cat. Amphip. Crust. Brit. Mus., p. 353.)

Caprella novæ-zealandiæ, sp. nov.

Cephalon furnished with a spinous tooth directed forwards; first segment of the pereion rather short, second long, third and following gradually decreasing; superior antennæ two-fifths the length of animal; flagellum with the infero-distal extremity of each articulus produced, but *without* cilia; inferior antennæ not so long as the peduncle of the superior by one joint; second pair of gnathopoda articulating behind the centre of second segment of pereion; propodos ovate; palm armed with a prominent posterior tooth, against which the closed dactylos impinges, and a smaller but distinct anterior tooth (not lobe); dactylos very much curved; three posterior pairs of pereiopoda have the anterior margins excavate and ciliate; the parts against which the closed dactylos impinges, armed with a strong tooth.

Length 1 in.

Hab: Cook Strait.

This species approaches *C. geometrica*, Say, (Cat. Amphip. Crust. Brit. Mus., p. 357), from which it differs, however, in the form of the spine on the cephalon, in the length of the antennæ, and in the articulation and arming of the second pair of gnathopoda.

Caprella lobata, Guérin.

Squilla lobata, Müller, O. Fabr. Faun. Grönl., p. 248.

Caprella lobata, Guérin, Iconogr. Crust., pl. 28, f. 22.

„ „ Krøyer, Voy. en Scand., pl. 25, f. 3.

„ „ Stimpson, Nat. Hist. Invert. Grand Manan., p. 44.

Ægina longicornis, Krøyer, Voy. en Scand., pl. 26, f. 3.

Caprella laevis, Goodsir, Edinb. New Phil. Journ., XXXIII.

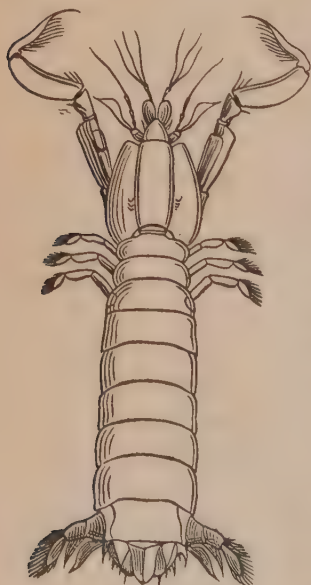
„ „ White, Hist. Brit. Crust., p. 215.

Caprella linearis, Leach, Edinb. Encycl., p. 404.

Body carrying a few minute tubercles, the most conspicuous being the one on the cephalon, and the most constant those upon the posterior segments of the pereion. First segment of the pereion long; second scarcely longer than the first; the three succeeding rather shorter, sub-equal. Superior antennæ not half the length of the animal; inferior scarcely reaching beyond the second joint of the peduncle of the superior. Second pair of gnathopoda articulating with the pereion posteriorly to the centre of the second segment; propodos long-ovate, palm defined by one and armed with two teeth, the anterior one being often less perfectly defined than the posterior. Three posterior pairs of pereiopoda having the propoda with the anterior margin excavate; the part against which the closed dactylos impinges armed with two stiff corrugated spines.

Hab: Cook Strait.

The only examples of the genus *Squilla* yet recorded from New Zealand are *S. nepa*, Cat. N.Z. Crust., p. 89, and *S. armata*, M. Edw., Trans. N.Z. Inst., IX., p. 474. It is with very great pleasure I now add a third. In addition to the specimen exhibited, which was obtained at the Chatham Islands, another, unfortunately mutilated, was secured by H. B. Kirk while on a visit to Kapiti.



Squilla indefensa, sp. nov.

Rostral plate semi-oval, and pointed at its distal extremity. Carapace retracted in front, expanded and rounded behind, smooth, the antero-lateral angles rounded and slightly produced forward; large prehensile limbs with terminal joint as long as preceding one, and armed with *nine* spines; abdomen smooth, terminal segment with six marginal spines, and three depressed longitudinal ridges which terminate posteriorly in spines.

Length, $2\frac{1}{2}$ inches.

Hab: Chatham Islands and Kapiti.

This species is easily distinguished by the absence of carinæ on the abdomen, and by the absence of the antero-lateral spines of the carapace.

Ebalia.

Ebalia, Leach, Zool. Misc. III.

External antennæ extremely minute, inserted in the inner canthus of the orbit; internal antennæ lying in oblique fossæ, which are entirely separated by a small process of the epistome, and concealed by the front; external pedipalps elongato-triangular, reaching forward to the margin of

the epistome; the internal footstalk gradually acuminate, the third joint internally palpigerous; anterior legs large, equal, the hand inflated, those of the male larger than those of the female; the other legs shorter than the first pair, diminishing gradually in length, terminating in a slightly curved, rather strong claw; abdomen seven-jointed, but with several of the middle joints confluent; that of the male narrow; of the female very broad, the last joint very small, abruptly narrower than the preceding; carapace rhomboidal, with the angles more or less truncated or rounded; front produced, elevated; eyes very small; orbits with two small fissures on the superior margin.

Ebalia tumefacta. Bryer's Nut Crab.

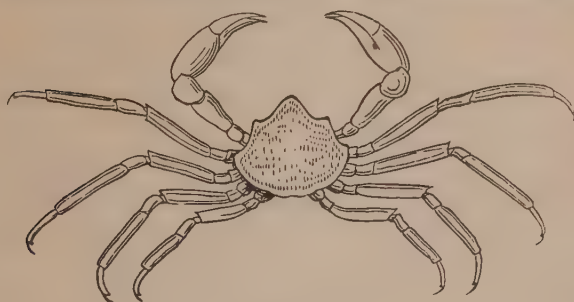
Cancer tumefacta, Mont., Trans. Linn. Soc. IX., p. 86, T. II., f. 3.

Ebalia bryerii, Leach, Mal. Podoph. Brit., T. XXV., f. 12-13.

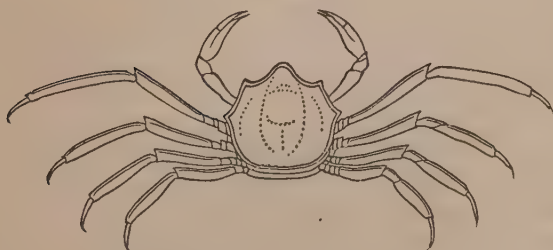
Carapace slightly and minutely granulated; lateral margin entire, somewhat revolute at the angles; two tubercles on the cardiac region, and one on each of the branchial in the male; these parts very tumid in the female; abdomen in the male with the third to the fifth joints united; in the female the fourth to the sixth; arm not more than twice as long as it is broad. (Bell's Brit. Crust., p. 145.)

Hab: Cook Strait. A single female, and the right anterior leg of another specimen.

Elamena producta, sp. nov. New Zealand Spider crab.



Male.



Female.

Carapace flat, broader than long, margin with two teeth, which, however, vary much in size; rostrum very prominent; anterior legs in male large and equal, hand and wrist much swollen; fingers curved and armed with hairs along their inner margins; in the female these legs are slight, and the fingers almost straight; succeeding legs very flat, the anterior margin

of the first joint produced so as to form a very prominent point, almost a spine; claws half the length of preceding joint; whole animal destitute of hair, except on the fingers. Length, $\frac{3}{4}$ in.; breadth, $\frac{4}{5}$ in. First three pairs of ambulatory legs very long, more than twice the length of the carapace.

Hab: Wellington.

Petrolisthes elongatus, Miers.

In the 'Catalogue of New Zealand Crustacea,' p. 60, this species is said to be of a "reddish-yellow" colour. The specimens from which the description was drawn up must have been preserved in spirit. This change of colour is usual in specimens so treated. The following is taken from living examples.

Above dark blue, greenish-blue, or sometimes even black. Below green, getting much darker towards the posterior margin of the anterior legs, anterior face of wrist a bright red, mobile finger and antennæ deep brown.

Porcellana rupicola, Stimpson.



A single specimen of this species was recently obtained by myself at Lyall Bay, living apparently upon terms of intimacy with a large family of *Petrolisthes elongatus*. Upon a comparison with the foreign Crustacea in the Colonial Museum, I find it to agree in every particular with a specimen contained in the collection lately received from Prof. Button of the

University of California, and labelled as above.

Unfortunately I have not been able to obtain the description either of this or the next species, but there can be no doubt respecting their identity, as those forwarded by Prof. Button are duplicates of the U.S. Exploring Expedition's collection.

This species may be easily distinguished from *Petrolisthes elongatus* by its having the posterior margin of the wrist produced, so as to form one strong tooth, by its more drooping front, and by having the lateral margins obtuse instead of thin and sharp. Length, $\frac{3}{4}$ in.; breadth, $\frac{4}{5}$ in.

Xantho spino-tuberculata, Lockington.

A fine pair of this beautiful little crab was procured at Porirua Harbour, in January of last year, and although only about half the size of the Californian specimen, there can be no mistaking their identity.

The carapace is much broader than long, the front armed with spinous tubercles; regions well defined; anterior legs strong, equal, the outer and

upper surfaces covered with very prominent tubercles; fingers brown, tipped with white, smooth, except their internal margins, which are armed with 3 or 4 tubercles. Ambulatory legs densely covered with hairs.

Male, length $\frac{6}{16}$ in., breadth $\frac{2}{16}$ in.

Female, length $\frac{5}{16}$ in., breadth $\frac{3}{16}$ in.

ART. LVI.—On some New Zealand Aphroditæ, with Descriptions of supposed new Species. By T. W. KIRK, Assistant in the Colonial Museum.

[Read before the Wellington Philosophical Society, 30th October, 1878.]

Aphrodita.

Halithea, Savigny, Syst. Annel. 11 and 18. Lam., An. s. Vert., v. 306.

Aphrodita, Leach, in Suppl. Encyclop. Brit. I., 452; Aud. and M. Edw., Litt. de la France, II., 63; Blainville in Dict. des Sc. Nat. LVII., 455; Fleming in Encyclop. Brit., Edit. 7, XI., 221; Johnston in Ann. Nat. Hist. II., 427.

Body ovate or oblong, the back convex, covered with fifteen pairs of scales, either concealed by a felt or exposed; the venter distinctly separate, flat, marked with the dissepiments and a longitudinal mesial furrow; antenna one, mesial, small; the palpi two and long; segments 39, with scales on the second, fourth, fifth, seventh, and every alternate segment to the twenty-fifth, and on the twenty-eighth and thirty-second; the intervening segments with a dorsal cirrus; feet stout, biramous, with three fascicles of bristles, two on the dorsal and one on the ventral branch; and each foot has a ventral setaceous cirrus; bristles various, simple or compound, with a spine in each fascicle; no anal styles.

A. aculeata.

Aphrodita aculeata, Linn. Sys. X., 655; XII., 1084.

Body from 3 to 8 inches long, oval, narrowest behind, convex dorsally; the back of an earthy colour; roughish, with a thick close coat of hair and membrane, forming a sort of skin, which entirely conceals the scales; the sides clothed with long silky green and golden hairs clustered in fascicles, and glistening like burnished metal, with blackish-brown spiniform bristles intermixed; ventral surface flat, often light coloured and dotted, sometimes dark brown, obsoletely ribbed across; head small, entirely concealed, roundish, with two round clear spots or eyes on the vertex; antenna minute; palpi large, subulate, flesh-coloured or dusky, jointed at the base, where they approximate, but are separated by a black membranous crest; mouth with a large edentulous proboscis; the orifice encircled with a short, even, thick-set fringe of compound penicillate filaments divided into two

sets by a fissure on each side; each filament has a short stalk, with a tuft of numerous forked papillæ on its summit; exterior to the orifice of the proboscis there are four fleshy tubercles placed at the angles; scales fifteen pairs, roundish, smooth, thin and vesicular, blotched with black stains and specks, the first pair small, laid over the head, the anal pair oval; feet thirty-nine pairs, largest and most developed near the middle of the belly, very small and approximate at the anus, biramous, the branches wide asunder; the superior carries, in a sort of crest-like fashion, the long, flexible, brilliant-coloured bristles which form the silky fringe on each side of the body, and above them some still more delicate hairs, which, by their intertexture, constitute the membrane covering the scales, and with which the strong spiniform bristles are intermixed, placed in a sort of cross series; the inferior branch is armed with three rows of stout, short bristles; in the upper row only two or three, which are longer and stouter than those of the next row, in which there are five or six, and which again are stouter but less numerous than those in the lower row; spine golden-yellow, conical, smooth; superior cirrus long, subulate, bulged at the base; the inferior short and conical; anus large, with a dorsal aspect, encircled with several tentacular cirri.

"The very vivid iridescent hues, which the hairs of this remarkable worm reflect, render it an object of wonder and surprise to the most incurious; they are not equalled by the colours of the most gaudy butterfly, and rival the splendour of the diamond beetle. It creeps at a slow pace, and in its progress a current of water is ejected at short intervals, and with considerable force, from the anus. When placed in fresh water, the creature gives immediate signs of its painful situation, and soon dies, first ejecting a white milky fluid, and in the agony of death, a large quantity of blackish-green turbid liquor. The size and strength of the proboscis is remarkable, and not less so the structure of the filaments which garnish the orifice. The œsophagus is short; the stomach and intestine seem to be alike and inseparable; together they form a straight intestine, sometimes with a wide dilation in some part of its canal, with a velvety inner surface folded into longitudinal plaits near the termination at the anus." (Cat. Worms, B.M., p. 104.)

I have quoted Dr. Johnston's descriptions and remarks at some length, in the hope that the attention of local collectors being called to this branch of our fauna, we shall soon possess better specimens of this very interesting group than are at present to hand.

Unfortunately our specimen, which is very young, does not show the brilliant iridescent colours mentioned above; it is of a uniform dull brown, but after a very careful examination and comparison with two specimens

from Europe contained in the collection of Annelids in the Colonial Museum, I have not the slightest hesitation in referring it to this species; it was obtained, together with specimens of the following species, amongst a mass of tangled seaweed, thrown up in August last, at Worser Bay.

Lepidonotus.

Lepidonotus, Leach in Ann. Phil. XIV., 205 (1819), and in Supp. Encyclop. Brit. I., 452. *Lepidonote*, Oersted, Annul. Dan. Conspect. 12; Annul. Dorsibr. 11.

Polynoë, Savigny, Syst. Annel. 20. Lam. An. s. Vert., V. 308, Aud. and M-Edw. Litt. de la France, II., 74. Cuv. Régn. Anim., III., 207. Johnston in Ann. Nat. Hist., II., 428 and 431. Williams, Rep. Brit. Assoc. 1851, 217.

Eumolphe, Blainville in Dict. des Sc. Nat., LVII., 457.

Body oblong, flattened, obtuse and rounded at both ends, composed of a definite number of segments, the back covered with two rows of scales; head distinct with two pairs of eyes on the sinciput; proboscis fringed with simple tentacles at the orifice, and furnished with two jaws; antennæ 3; palpi 2; tentacular 2 on each side; these are similar in structure, and jointed only at the base; scales naked, 12 placed over every alternate segment, so that the 12th is on the 23rd; if there are more scales, the succeeding are on every third segment; feet well developed, biramous, but the branches are almost connate, furnished with two fascicles of bristles, the superior in a spreading tuft, the inferior in a flattish brush, a spine on each fascicle; bristles simple, stout, the superior tapered to a serrulate point; the inferior with a claw-like point, and flattened underneath on one side of the shaft, where it is roughened with spinous tentacles in claw-set transverse series; anal segment with styles.

“*Lepidonotus* is easily distinguished from *Aphrodita* by the number of the antennæ, by the more powerful armature of the mouth, and by the part of the body at which the scales cease to alternate with the cirri. The back is either entirely covered with scales, or naked in the middle, the scales in the latter case being less developed, and not meeting on the mesial line.”

“The *Lepidonoti* are carnivorous. They prey on living invertebrates, and the strong do not hesitate to kill the weak of their own and allied species; they live in obscurity on rocky shores, and can move with considerable quickness. Some of them swim easily in a wriggling manner, but they hasten to find the bottom. They have the power of renewing the scales, which are frequently removed by abrasion and injury.”

Lepidonotus squamatus.

Aphrodita squamata, Linn. Syst. X. 655; XII. 1084.

Lepidonotus squamatus, Johnston, Cat. Worms B.M., p. 109.

“Body generally about one, rarely two inches long, depressed, linear-oblong, of equal breadth at both ends, of a uniform cinereous colour, rough; scales twelve on each side, rather large, ovate, imbricate, rough with brown

granulations, ciliated on the external margin, the overlapped smoother than the exposed portion, for the granules on the former are more minute than on the latter; the anterior scales are smaller and rounder than the others, and completely cover the head, which is a sub-triangular pink or purplish corneous plate, furnished with four small eyes; antennæ three, the central one largest, bulbous near the point; palpi two, longer than the antennæ, swollen near the apex; the tentacular cirri similar to the superior cirri of the feet, these are white, with a blackish ring at the bulb where the acumination commences, retractile, originating from above the dorsal branch of every alternate foot, and under the scales; the last three pairs of feet each with a cirrus; feet twenty-five pairs, obtuse, sub-bifid, the dorsal branch shorter and less than the ventral, each terminated with a brush of stiff brown bristles, and under the ventral branch there is a small setaceous cirrus, and also a fleshy spine at its junction with the belly; bristles when removed golden-yellow, those of the dorsal branch slenderest, gently curved, pointed, and serrulate for about half their length, those of the ventral branch stouter, slightly bent near the top, and serrulated with a double series of teeth on the outer side of the bend, each tuft of bristles enclosing a dark brown straight spine, the inferior stouter than the upper one; ventral surface straw colour, prismatic, marked with the viscera, and sometimes spotted with black near the base of the feet." (Cat. Worms, B.M., p. 107.)

Two very fine specimens of this species were obtained at Worser Bay in August last.

Lepidonotus giganteus, sp. nov.

Body elliptical, rather broader posteriorly than in the front; convex dorsally, of a brown colour, tinged with slate; scales ovate, imbricate, coarsely granulate, projecting beyond the sides of the body, towards the posterior and lateral margins of each scale the granulations assume the character of short stout spines, external margins ciliated, the overlapped smoother than the exposed portion; anterior scales smaller than the others, sub-circular, very coarsely granulous, completely covering and projecting beyond the head; twenty-five pairs of feet, sub-bifid, the dorsal branch much the smaller, and carrying a bunch of *silky hairs*, while the ventral is armed with a bundle of *coarse bristles* of a deep golden colour. Under the ventral branch is a fleshy cirrus. A very obtuse fleshy spine marks the junction of each foot with the belly; ventral surface a pale yellowish white.

Length, 4 inches; breadth, $1\frac{4}{10}$ inches.

Hab: Wellington.

ART. LVII.—Notes on some New Zealand Crustaceans. By T. W. KIRK,
Assistant in the Colonial Museum.

[Read before the Wellington Philosophical Society, 11th January, 1879.]

Squilla, Fabr.

Squilla armata, M. Edw., Hist. Nat. Crust., II., p. 521; Gray, Hist. Chile, Zool., Vol. III., Crust., p. 223; Trans. N.Z. Inst., Vol. X., p. 474.

Several very fine specimens of this species were recently obtained in Wellington Harbour.

At the same time a specimen was procured differing from *S. armata* in having a high median crest on the carapace; no spines on the ophthalmic segment; only five spines on the terminal joint of the prehensile limbs, and a nearly square rostral plate.

The specimen is much broken, the whole of the thoracic segments are missing. Length about 5 inches.

Squilla indefensa, Mihi.

A third specimen of this species was shown to me a short time since; it was procured at Waikanae by Mr. J. Taylor, a student of the Wellington College, and is now preserved in the Museum of that institution.

Calocaris, Bell.

Calocaris macandrea, Bell; Brit. Crust., p. 231.

Two specimens of this remarkable Crustacean were obtained by myself a few weeks since, on the Otaki beach, near the wreck of the 'City of Auckland.' Although they must have been lying on the sand for some hours at least, one of them showed distinctly the delicate pink colouring mentioned by Prof. Bell in his description.

Callianassa, Leach.

Callianassa. sp. ind.

A specimen undoubtedly referable to this genus has been obtained by Mr. H. B. Kirk, at Island Bay. The carapace is much broken; right claw the largest. Total length, $1\frac{1}{2}$ inch.

Gebia, Leach.

Gebia hirtifrons, Dana; U.S. Explor. Exped., XIII., Crust., part I., p. 511.

A specimen in the private collection of Mr. H. B. Kirk appears to belong to this species. It measures $2\frac{1}{2}$ inches in total length, "the hand slender, hairy, and not denticulated below; the wrist has a spine at its upper apex and one on the inner margin, but none at the lower apex;" legs hairy; "front hardly, if at all, three-lobed."

The specimen agrees well with the figure of *G. hirtifrons*, in the Zoology of the Voyage of H.M.S.S. 'Erebus' and 'Terror.'

There are also in the collection specimens agreeing well with the description of *G. danai*, Miers.

Portunus, Leach.

Portunus pusillus, Leach, Malac. Brit., t. IX., f. 5-S; Edwards, Nat.

Hist. Crust., I., p. 444; Bell, Brit. Crust., p. 112.

Three specimens agreeing well with Prof. Bell's description are in the Colonial Museum; the only difference being that the New Zealand specimens have a prominent spine on the anterior margin of hand.

Female, length, $\frac{5}{16}$ inch; breadth, $\frac{6}{16}$ inch. Male, length, $\frac{4}{16}$ inch; breadth, $\frac{5}{16}$ inch.

Hab.: Cook Strait.

Podocerus, Leach.

Podocerus cylindricus, Say, Jour. Acad. Philad., I., part 2; Edwards,

Hist. des Crust., III., p. 64; Cat. Amp. Crust. B.M., p. 256.

Three specimens were obtained at Worser Bay, in tangled seaweed.

Pleustes, Spence Bate.

Pleustes panoplus, Kroyer, Grön. Amf., p. 42, pl. 2, f. 9; Edwards,

Hist. des Crust., t. III., p. 41; Cat. Amp. Crust. B.M., p. 63.

Seven specimens at same time and place as last species.

These are both arctic species, and their occurrence on our coast is somewhat remarkable.

Date Due

